Learning by litigating: An application to antitrust commitments

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Learning by litigating:
An Application to Antitrust Commitments

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Abstract

This paper examines the impact of commitment decisions on the efficiency of antitrust enforcement. We discuss the optimal use of commitments considering past rulings as a source of knowledge to better assess future similar antitrust cases. Our framework combines two key effects: the deterrence of the anticompetitive behavior by the different enforcement regimes, and the dynamic perspective through litigation as a source of learning. We show that if the level of penalty is high enough, the antitrust authorities undervalue the dynamic informational benefit of litigation and tend to over-use commitments.

Keywords: antitrust, commitments, deterrence, legal learning

JEL classification: L41, K21, D82

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1 Introduction

Currently, two options are available for most competition agencies to address an antitrust violation from unilateral anticompetitive conduct: either rule on an infringement through formal litigation, or instead reach a negotiated settlement with the firm, also called commitments decisions (Europe) or consent decrees (US).[1]

These two enforcement tools lead to different outcomes. Litigation results in a formal prohibition of the practice together with the payment of a fine if the firm is eventually convicted. But litigation requires a robust theory of harm based on strong evidence. The alternative is to reach a settlement and fix the anticompetitive effect of the practice by negotiating commitments with the firm. Each procedure involves costs and benefits. The key social benefit of a commitments procedure is an earlier restoration of market competition for lower administrative costs. In contrast, the main benefits from a prohibition decision are the deterrence through monetary sanctions and the creation of precedents that may improve future enforcement. Indeed, when using commitments, the competition agency does not formally identify an infringement, and the firms admit no wrongdoing,[2] which impedes the creation of precedents. Following Landes and Posner (1976, p. 250 and 251), legal precedents may be viewed as an investment to increase the stock of knowledge useful for the assessment of future cases: competition agencies and courts of justice learn from litigating. Several recent antitrust cases epitomize the implications of the lack of learning from commitment decisions. After filing a case against the major US studios and Sky UK for geoblocking agreements in 2015,[3] the EC finally closed it in 2019 after all investigated parties had

[1] See OECD (2016).

[2] "Commitment decisions should find that there are no longer grounds for action by the Commission without concluding whether or not there has been or still is an infringement". (Recital 13 of Council Regulation (EC) No 1/2003 of December 2002).

[3] Case AT.40023 – Cross-border access to Pay-TV.

offered commitments. However, the main legal question raised by the case (copyright infringement and parallel trade within the common European market) was left unresolved. The latest decision of the European Court of Justice in this case emphasizes that a commitments decision only requires a preliminary assessment of the practice, whereas establishing the existence of an infringement must follow from a thorough examination.[4] Formal rulings need a solid theory of harm, that may be used in future similar circumstances. After many years where the EC dealt with the abusive royalties in standard essential patent cases by means of commitments, a formal decision was eventually reached in the Motorola case that clarified the law and set a precedent.[5] The European Commission openly acknowledged this potential for learning from formal rulings: it recently fined Google €2.42 billion for breaching EU antitrust rules and stated that "Google has abused its market dominance as a search engine by giving an illegal advantage to another Google product, its comparison shopping service. [...]Today's decision is a precedent which establishes the framework for the assessment of the legality of this type of conduct".[6] Surprisingly, albeit planning to enforce prohibitions whenever there is significant need for "deterrence, punishment and legal precedent",[7] the European Commission issued only very few prohibition decisions in novel areas of intervention for which legal guidance is much needed.[8] Since the entering into force on May 1 2004 of the Council Regulation No 1/2003 making room for commitments, the European Commission has heavily relied on such decisions to deal with antitrust

[4]See case C-132/19 P Groupe Canal + v. Commission - December 9th, 2020.

[5]Case 2014/C 344/06.

[6]Brussels, 27 June 2017 - IP 17/1784, at https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784

[7]See Alexander Italianer, Director General of the Commission's Competition Directorate-General, speech of 11 December 2013 at the CRA Competition Conference, http://ec.europa.eu/competition/speeches/text/sp2013_11_en.pdf.

[8]See Marinielllo (2014) for examples on patent abuse in standard setting, air transport, energy or new media/ebooks.

violations: more than 60% of the antitrust cases (excluding cartels) did not formally sanction a violation, and more than 70% of the abuse-of-dominance cases were resolved with commitments (Mariniello, 2014).[9]

In this paper we discuss the optimal use of antitrust commitments. Our primary goal is to understand how a forward-looking and benevolent competition authority (CA henceforth) may balance the present and future costs and benefits (saving of litigation costs vs lower deterrence and weaker learning process) of using commitments rather than pronouncing a formal prohibition decision.

For this purpose we develop a theoretical model to contrast two enforcement regimes: "the strict enforcement" where the antitrust authority cannot propose commitments to firms in order to fix the alleged anticompetitive behavior, but instead commits to always litigate the case, and the "flexible enforcement" which allows the CA to choose between proposing commitments and going to trial. Our broad objective is to identify the social cost and benefit associated with each enforcement regime. To do so we consider alternatively two cases: first a purely static analysis, to grasp the basic trade-off between litigation and commitments. Then we turn to a dynamic setting, where present rulings afford better knowledge on future similar cases: the CA learns to correctly determine case facts in future cases by litigating present ones.

We start with the purely static analysis and show that the flexible enforcement leads the CA to propose commitments too often. Being able to choose between commitments and litigation leads the CA to neglect the higher deterrence effect of litigation, and instead focus only on the saving of trial costs following a commitments offer. We show that the ability of the CA to assess accurately cases before possible litigation has an ambiguous impact on this static bias towards commitments. Indeed, if anticompetitive

[9]The same trend is noted in the US, where the FTC and DoJ have "resolved nearly their entire civil enforcement docket by consent decree" - Wright and Ginsburg (2018).

practices are quite accurately detected by the CA, then commitments are efficient in saving on litigation costs. However, the accurate detection of anticompetitive practices also makes litigation a valuable enforcement tool by imposing fines and thus efficiently deterring the anticompetitive practices. In the end, if the deterring effect of litigation is high enough, a better assessment of cases reinforces the efficiency of the strict enforcement.

We then go on to examine a dynamic setting where the procedural choice is made at each period, and for which we assume that present litigation increases the accuracy of future detection. The question we address is to what extent the systematic static bias in favor of commitments may cause a dynamic inefficiency by distorting the CA's assessment of the future situations. We show that the static bias is either neutral or leads the CA to undervalue the future informational benefit from present litigation. Again, the deterrence achieved by the CA's detection activity is critical for this outcome: as explained before, a better future detection accuracy tends to make the litigation procedure optimal if deterrence is strong. This implies that in this case, the future CA's decision to favor the commitments is a source of an even stronger such bias at the present period. The policy implication of our results is that the flexible enforcement fosters excessive incentives to use the commitments procedure when the antitrust enforcement produces substantial deterrence of anticompetitive practices. This is true in a static context, but taking into account the dynamic learning effect of litigation reinforces this result. Instead, a weaker deterrence, due to lower fines in case of conviction for instance, will lower the opportunity cost of using the commitments procedure.

The paper unfolds as follows: next we review the related literature and our contribution to it. Then we present our model and examine first the static choice between litigation and commitments, before looking into this trade-off in a dynamic setting.

2 Contribution to the related literature

This paper examines the optimal use by a Competition Agency of the two options available to dispose of an antitrust violation case, namely prohibition or commitment decisions. Since the latter allow to avoid the costly trial, our paper is connected to the law-and-economics literature on pre-trial settlement (see Daughety and Reinganum (2011) for an in-depth survey). In particular, our static analysis closely mirrors the screening model of Bebchuk (1984), since the uninformed party makes the take-it-or-leave settlement offer,[10] but in contrast, we endogenize the primary conduct of the defendant. Our paper actually belongs to a specific strand of the literature on pre-trial settlement that considers the context of antitrust with a public authority (the CA) as the plaintiff. The paper closest to ours is the preliminary work of Polo and Rey (2016), which uses the signalling/informed-party-making-the-settlement-offer framework to show that commitment decisions are appropriate only when the practice is socially harmful, when it is particularly damaging, and when gathering information is costly enough for the agency. Their paper endogenizes the firms' choice of practice, as well as the enforcement regime (litigation or commitments), but does not consider the CA's ability to detect the true nature of the practice undertaken by firms. This in turn is a crucial feature of our model, driving the optimal enforcement decision. In addition, Polo and Rey (2016) assume a static, one-shot interaction between parties.[11]. We

[10] Spier (1992) considers a finite-horizon ultimatum game with uninformed party making the settlement offer, to show that there is a high likelihood of settlement in the last period. Reinganum and Wilde (1986) examine the opposite, signalling framework, where the informed party makes the settlement offer. Nalebuff (1987) relaxes the commitment to litigate if the settlement negotiation fails. In the Appendix we argue the credibility of going to trial in our setting.

[11] Choné et al. (2014) and Gautier and Petit (2018) also examined the trade-off between litigation and settlement in antitrust, but still in a purely static setting. The one-shot game in our paper allows for the firms'endogenous behavior, which is absent from Gautier and Petit (2018). Choné et al. (2014)

consider instead a dynamic framework, making room for information arrival through trial, and thereby improved detection of other similar cases.

Judicial learning is typically associated with the evolution of legal rules. Although we do not model setting precedents, our framework does exhibit a decision in a current case affecting future decisions. So, to a certain extent, our analysis is close to some contributions dealing with the evolution of law through judicial decision-making. In particular, our dynamic setting in which the agency's decision to litigate improves its own ability to detect future similar cases parallels Parameswaran (2018). This paper builds on Baker and Mezzetti (2017), where the court of law decides whether to summarily dispose of the case, or instead conduct a costly investigation to learn the ideal outcome, thus balancing between adjudication costs, potentially wrongful rulings, and the dynamic effect of better information on future court decisions.[12] While Baker and Mezzetti (2017) assume a random arrival of cases to be tried, Parameswaran (2018) extends their analysis by considering an endogenous distribution of cases to be disposed of, as we also do. Another feature our paper shares with Parameswaran (2018) is that present litigation provides information on the true nature of the practice, thereby reducing future uncertainty. In his paper this will feedback into firm's behavior, since the adoption of the harmful conduct depends on the court's precedent-setting policy. In our paper we address the agency's potential under-incentives to reduce future uncertainty through judicial learning because of future sub-optimal enforcement. In this sense, the two papers complement each other. Chen and Eraslan (2020) is another related paper studying the impact of learning for the evolution of legal rules, which

do not allow for different types of practice, nor examine the role of improved detection, as we do.

[12] A similar trade-off is present in Anderlini et al. (2014), where the court may be either constrained by precedents (which evolve according to a dynamic process) or unconstrained. Gennaioli and Shleifer (2007) provided another dynamic model of (common) law evolution, with possibly biased judges endorsing the existing precedent.

also builds on Baker and Mezzetti (2017). They consider a decision-maker ruling on a random case at each period, possibly bound by precedent but improving the quality of that decision by conducting a costly investigation. The purpose is to examine the dynamic consequences of binding or non binding precedents on the decision maker's incentive to acquire information. We also examine in a dynamic framework a decision-maker's (the CA in our case) incentives to acquire information, but focus instead on the impact of future enforcement on these incentives at the current period. While Chen and Eraslan (2020) study the role of binding precedent on the future incentives to acquire information, in our model it is the choice of litigation at the present period that represents a costly investment for future detection accuracy. In that sense, our paper is also related to the literature on learning through litigating. Maggi and Staiger (2020) in particular discuss how judicial learning may lead to litigation. For this, they consider a court whose quality of decisions rises as it learns from past rulings, and show that a lower frequency of disputes and rulings over time is consistent with learning from cumulative judicial decisions. Our dynamic model also exhibits this endogenous accumulation of knowledge, but resulting from the CA's decision to litigate, whereas Maggi and Staiger (2020) relies on the parties' (countries engaged in a trade dispute) decision to go to trial. Moreover, we endogenize the enforcement regime, allowing or not for settlements, as well as the firms' underlying behavior, in contrast to Maggi and Staiger (2020).

3 The model

The players and their information

A firm may adopt or not a given practice, which can be either pro- or anticompetitive. The true nature of the practice (i.e anti- or pro-competitive) is observed by the

firm. We denote by A the type of the firm that may adopt an anticompetitive practice, and P the type of the firm that may adopt a pro-competitive practice.[13] Each type has the same *a priori* probability $\frac{1}{2}$. Adopting the practice, whatever its type, requires a fixed cost of k. This cost is uniformly distributed on the interval $[0, K]$ according to the cdf $F(x) = \frac{x}{K}$. The cost of the practice is firm's private information. Whatever the type of practice, the firm benefits from it: the resulting profit increase is equal to $\pi^i > 0$ for type $i = A, P$. The adoption of the practice of type A has a negative welfare impact equal to $-W^A < 0$ while the practice of type P has a positive welfare impact of $W^P > 0$. The welfare impact is the welfare change with respect to the non adoption of the practice. It includes the entire external effect on competitors and consumers.

The antitrust enforcement

The agency gathers pieces of evidence on the possible anticompetitive nature of the practice with probability e. This probability depends on the true type of the practice (A or P) :

$$e = \begin{cases} \sigma \text{ if } i = A \\ 1 - \sigma \text{ if } i = P \end{cases}, \text{ with } \sigma \geq \frac{1}{2}.$$

Parameter σ captures the detection accuracy of the CA.

The CA may start a procedure against the practice only if it has gathered pieces of evidence. Two different procedures are available to dispose of a case:

*The litigation procedure (labelled **Lit**).*

In this case, the CA aims to ban the practice. The prohibition is eventually enforced after a formal process of confrontation of evidence, possibly in a court of law. To capture this formal process, we assume that litigation occurs between the firm and the CA. We denote T the social cost of litigation proceedings. The cost of litigation for the firm is denoted c. We assume c is distributed on $[0, \overline{c}]$ according to the cdf $G(x)$ and the

[13] We follow Kaplow (2011) in making this modelling assumption.

density function $g(x)$. The trial allows to discover the true nature of the practice with probability $\gamma > 0$. With probability $1 - \gamma$, the trial outcome is inconclusive and does not allow to discover the true type, in which case the firm incurs no liability. When convicted, the firm must stop the practice and pays a fine. We denote f the monetary penalty incurred upon conviction. We assume that $\pi^P > \bar{c}$, meaning that litigation is always worthwhile for type P. This setting captures, in a nutshell, the infringement proceedings specified by Article 7 of the European antitrust regulation.[14]

The Commitments procedure (labelled ***Com****).*

This procedure allows the CA to negotiate commitments with the firm. We summarize this settlement process by a commitments offer made by the CA that the firm may accept or not. This mirrors the proceedings of article 9 of the European antitrust regulation. In case of refusal by the firm, the CA commits to engage the formal litigation process described above and the trial occurs[15]. We assume that the only possible commitments consist in abandoning the practice: as a result, they will fully fix the anticompetitive concern if the practice is of type A, but will also cancel any welfare benefit if the practice is of type P.

The key element of our analysis is the intertemporal role of the litigation procedure. We consider that the trial has a direct impact on the future ability of both the CA and the judge upon trial to assess the actual nature of the practice. The trial consists of the confrontation of evidence and arguments regarding the practice, which improves the understanding of the latter whenever it leads to the discovery of the true nature of the firm's conduct. Thus, when faced next with a similar practice, the CA as well as the judge will be better informed: in case of conclusive trial at date t, and of similar practice at date $t + 1$, the probabilities σ and γ increase. In short, present litigated

[14] Council Regulation (EC) No 1/2003 of 16 December 2002.

[15] We discuss in the appendix the CA's engagement to litigate if the firm declines to adopt commitments.

cases are a source of knowledge and thus allows both the CA and the judge to be more accurate in the future. We adopt here the informational view of legal precedents following Landes and Posner (1976) (see also Spier (2007), p. 298) who explicitly consider that each litigated case increases the stock of knowledge for assessing future similar cases. In brief, the CA and the judge learn from successfully litigated cases.

We assume that the CA maximizes the net expected welfare.[16]

We contrast two types of enforcement. The first enforcement regime consists in not allowing the CA to offer commitments to firms. This "strict" enforcement has the CA impose litigation (procedure **Lit** only) and forbids commitment negotiation. The other type of enforcement is "flexible", to the extent that the CA chooses between both proceedings: either propose commitments to firms or directly go to trial. These two enforcement regimes lead to two different games that we describe below.

The "strict enforcement" game:

Stage 1 - The firm observes its type and the cost of the practice. The firm undertakes the practice or not.

Stage 2 - If the practice was adopted, the CA gathers pieces of evidence with probability e.

Stage 3 - If the CA obtained evidence, it decides to enforce or not the procedure **Lit**.

The "flexible enforcement" game:

Stage 1 - The firm observes its type and the cost of the practice. The firm undertakes the practice or not.

Stage 2 - If the practice was adopted, the CA gathers pieces of evidence with

[16]The net expected welfare is further explained below. It includes all the external effects i.e. W^i and the social trial cost, T. All private gains and costs are considered as mere transfers within the industry. In particular, the expected welfare does not include c, which is assumed to be a purely private transfer between the firm and the providers of legal services.

probability e.

Stage 3 - If the CA obtained evidence, it chooses the procedure to enforce: either **Com** or **Lit**.

Stage 4 - If procedure **Com** was chosen, the CA proposes commitments. The firm observes its litigation cost c and accepts or not the proposition. If the firm refuses commitments, procedure **Lit** is applied.

We represent in figure 1 and 2 each enforcement game. The flexible enforcement game allows the CA to choose between commitments and litigation while with the strict enforcement game, the CA commits to impose litigation (the dotted line does not exist).[17]

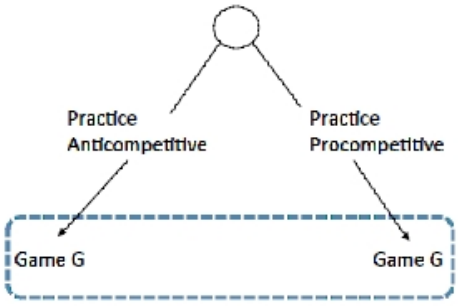

Fig.1

[17] In the Appendix we briefly justify the CA's choice to start litigation proceedings when it gathers evidence that the firm's conduct is anticompetitive.

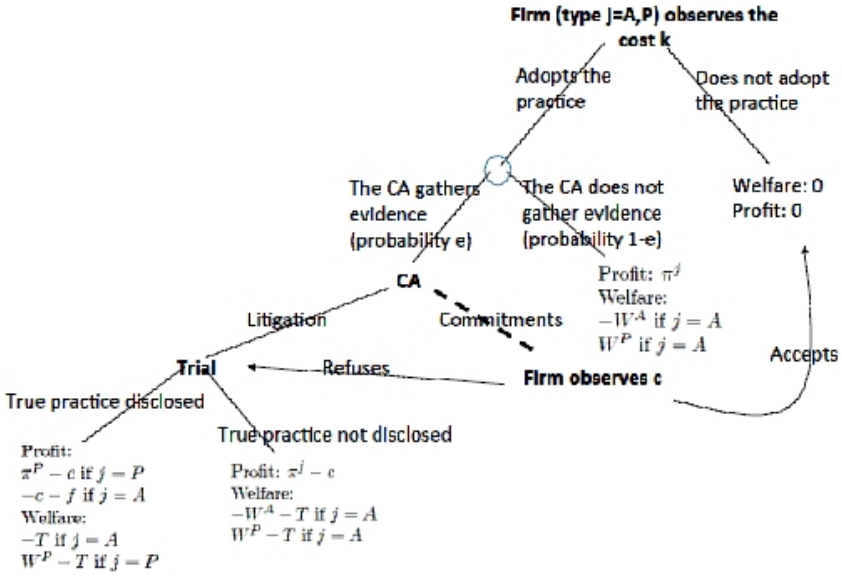

Fig.2

Before turning to the formal analysis, we sum up below the parameters affecting the firm's and the CA's choices (to undertake the practice, to accept commitments or to litigate, and to propose commitments or to litigate), which are displayed in the game trees above.

Industry parameters	
type and *a priori* probability of conduct	A, P; $1/2$
cost of adopting practice and its cdf	$k \in [0, K]\,, F(x) = \frac{x}{K}$
type-wise profit change	π^i, $i = A, P$
litigation cost and its cdf	$c \in [0, \overline{c}]\,, G(x)$
monetary fine if conviction	f
Antitrust parameters	
type-wise detection probability	σ if $A, 1-\sigma$ if P
type-wise welfare change	W^i, $i = A, P$
social cost of trial	T
trial accuracy probability	γ

In what follows, we first take a static perspective and determine the Perfect Bayesian Equilibria (PBE) of each game, so as to derive the optimal enforcement. Then we go on to consider a dynamic, two-period, enforcement game. When describing this two-period enforcement game later on, we shall also explain the CA's dynamic objective function.

4 The litigation-vs-commitment trade-off and the learning effect

4.1 The static choice

Our objective here is to derive the optimal enforcement and discuss to which extent the strict enforcement ought to be imposed.

4.1.1 The strict enforcement

We first examine the firm behavior under "strict" enforcement, i.e. when litigation is imposed. To avoid trivial cases, we assume that if the CA gathers evidence, it litigates the case[18].

At stage 1, the firm of type $i = A, P$ adopts the practice iff the expected benefit covers the cost of the practice. The expected gain for type A is equal to:

$\sigma\left((1-\gamma)\pi^A - \gamma f - \int_0^{\overline{c}} cg(c)dc\right) + (1-\sigma)\pi^A$.

Therefore, the probability for type A to adopt the practice is given by:

$a^{Lit}(\sigma,\gamma) = F\left[\sigma\left((1-\gamma)\pi^A - \gamma f - \int_0^{\overline{c}} cg(c)dc\right) + (1-\sigma)\pi^A\right]$.

By the same token, the probability for type P to adopt the practice is:

$p^{Lit}(\sigma,\gamma) = F\left[\pi^P - (1-\sigma)\int_0^{\overline{c}} cg(c)dc\right]$.

We deduce that the expected welfare net of social litigation cost under "strict" enforcement is given by:

$$W^{Lit}(\sigma,\gamma) = \frac{1}{2}p^{Lit}(\sigma,\gamma)\left[W^P - (1-\sigma)T\right] - \frac{1}{2}a^{Lit}(\sigma,\gamma)\left[(1-\sigma)W^A + \sigma((1-\gamma)W^A + T)\right].$$

The expected welfare is given by the sum of the welfare gain net of the social litigation cost in case of adoption of the pro-competitive practice (with probability $p^{Lit}(\sigma,\gamma)$), and the welfare loss net of the social litigation cost in case of adoption of the anti-competitive practice (with probability $a^{Lit}(\sigma,\gamma)$).

4.1.2 The flexible enforcement

We now consider the "flexible" enforcement game where the CA chooses between procedures **Com** and **Lit**. Below we determine the Perfect Bayesian Equilibrium of this game.

[18] If the CA does not start a procedure even if it gathers evidence, this amounts to pure *laissez-faire*. We provide in the Appendix (see the Discussion section) the condition for *laissez-faire* to be dominated.

When the CA chooses which procedure to enforce, her choice is based on beliefs regarding the probability to face either a type A or a type P firm. Let the CA believe that the probability for type A to have adopted the practice is a, and respectively p for type P.

If the CA chooses to impose litigation, the resulting expected welfare is equal to:

$$-T + \frac{(1-\sigma)p}{\sigma a+(1-\sigma)p} W^P - (1-\gamma) W^A \frac{\sigma a}{\sigma a+(1-\sigma)p}.$$

The expected welfare is composed of three terms: the social litigation cost that will always be incurred, the welfare gain of the pro-competitive practice (W^P) affected by the conditional probability to face a P-type, and the expected welfare loss from the anti-competitive practice ($-(1-\gamma)W^A$) affected by the conditional probability to face an A-type.

If instead the CA chooses to offer commitments, the expected welfare depends on the firm's decision to accept or refuse the commitments proposal. A type A firm accepts the commitments iff the expected profit in case of litigation, given by $(1-\gamma)\pi^A - c - \gamma f$, is lower than the zero profit earned if commitments were adopted. As a result, there is a probability $1-G(\widehat{c})$ for type A to accept the commitments, with $\widehat{c} = (1-\gamma)\pi^A - \gamma f$. In contrast, type P always refuses the commitments offer (since $-c+\pi^P > 0$ for all $c \leq \overline{c}$ by assumption). Therefore the commitment proposal triggers an imperfect screening of types, since type P always prefers to decline the offer and go to trial, whereas the decision of type A depends on her expected profit. The resulting expected welfare when the CA offers commitments is equal to:

$$\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}(W^P - T) - \frac{\sigma a G(\widehat{c})}{\sigma a+(1-\sigma)p}((1-\gamma)W^A + T).$$

Here, the expected welfare is composed, on the one hand, of the welfare gain of the pro-competitive practice net of the social litigation cost, $(W^P - T)$, affected by the

conditional probability to face a P-type, and the welfare loss from the anti-competitive practice adjusted for the social litigation cost, $(1-\gamma)W^A+T$, affected by the conditional probability to face an A type.

As a result, comparing both values of expected welfare, it is clear that the CA always proposes commitments: they allow some screening of types, albeit imperfect, which enables the CA to fix the behavior of a fraction of type A firms at no cost. This highlights the two main benefits of the commitments proposal: by inducing type A to accept remedies, not only does the CA's offer fix the anticompetitive concern of the practice, but it also avoids costly litigation to some extent.

We summarize this result as follows (see proof in the Appendix):[19]

Lemma 1 *At the Perfect Bayesian Equilibrium of the flexible enforcement game, the CA always offers commitments.*

Lemma 1 makes clear the extent to which the CA always has incentives to offer commitments. As before mentioned, this is due to the screening outcome, together with the fact that the commitments save on litigation costs.

4.1.3 The optimal enforcement in the static case

We have previously spelled out the expected welfare expression in the case of strict enforcement, and we can now do the same for the flexible one. This will enable us to compare both enforcement options.

[19] We show in the Appendix (section 6.2) that it is optimal for the CA to commit to litigation if the commitments proposal is not accepted. Thus, to the extent that the CA determines the optimal enforcement design, the flexible enforcement with CA's commitment to impose litigation if commitments are not accepted dominates the flexible enforcement without such a commitment from the CA.

Under flexible enforcement, given that at the PBE the CA always proposes commitments, the ex ante expected welfare is given by

$$\begin{aligned} W^{Com}(\sigma,\gamma) &= \frac{1}{2}p^{Com}(\sigma,\gamma)\left[W^P-(1-\sigma)T)\right] \\ &\quad -\frac{1}{2}a^{Com}(\sigma,\gamma)\left[(1-\sigma)\,W^A+\sigma G(\widehat{c})((1-\gamma)W^A+T)\right], \end{aligned} \tag{1}$$

with the probability for type A and P to have adopted the practice under the flexible enforcement (Com) denoted a^{Com} and p^{Com} respectively, where:

$a^{Com}(\sigma,\gamma) = F\left[(1-\sigma)\pi^A+\sigma\int_0^{\widehat{c}}((1-\gamma)\pi^A-c-\gamma f)g(c)dc\right]$ and

$p^{Com}(\sigma,\gamma) = p^{Lit}(\sigma,\gamma)$.

The optimal enforcement is determined by comparing the two expected welfare expressions, hence by the sign of $W^{Lit}(\sigma,\gamma)-W^{Com}(\sigma,\gamma)$.

The strict enforcement is more efficient than the flexible enforcement iff (see the Appendix):

$$W^{Lit}(\sigma,\gamma)-W^{Com}(\sigma,\gamma)>0 \tag{2}$$

iff

$$\underbrace{\frac{T+(1-\gamma)W^A}{W^A}}_{\text{Litigation cost (denoted }\lambda)} < \underbrace{\left(\frac{1-\sigma}{\sigma}\right)}_{\text{Detection effect}} \underbrace{\left[(1-G(\widehat{c}))\frac{a^{Com}(\sigma,\gamma)}{a^{Com}(\sigma,\gamma)-a^{Lit}(\sigma,\gamma)}-1\right]^{-1}}_{\text{Deterrence effect}} \equiv \lambda_S^*(\sigma,\gamma)$$

Condition (2) highlights the three different effects driving the choice of optimal enforcement: a litigation cost effect, a detection effect and a deterrence effect.

First, the litigation costs effect comprises both the direct cost of litigation, T, and the associated welfare loss, since with probability $1-\gamma$ the trial may be inconclusive. This effect goes against the strict enforcement, because the flexible enforcement allows the CA to save on litigation costs, given that type A may be induced to accept commitments rather than go to trial.

The second effect in condition (2) is the "detection effect": the CA has ability to detect, although imperfectly, the anticompetitive practices ($\sigma > \frac{1}{2}$) and thus, it faces a higher share of A-types than P-types. Because of the litigation costs, it is then more efficient to offer commitments, and thus this effect goes against the strict enforcement ($\frac{1-\sigma}{\sigma} < 1$).

Finally, we call the third effect in condition (2) the "deterrence effect": it is the change in incentives for type A. Explicitly, imposing litigation lowers the incentives for type A to adopt the practice ($a^{Lit}(\sigma, \gamma) < a^{Com}(\sigma, \gamma)$) and leaves those of type P unchanged (type P prefers litigation even when commitments are offered: $p^{Com}(\sigma, \gamma) = p^{Lit}(\sigma, \gamma)$). This deterrence effect stems from the higher cost incurred by the firm, since it will have to pay a penalty f in case of conviction upon trial, which cannot be avoided following the initial detection. This effect goes against the flexible enforcement. In particular the better deterrence of the penalty f on type A (the lower $a^L(\sigma, \gamma)$), the lower the deterrence effect term making more likely the optimality of the strict enforcement.

The trade-off between these three effects explains the optimal choice. Imposing litigation, i.e. the strict enforcement, will be optimal as long as the relative total cost of trial (denoted λ) is low enough. Note that the critical threshold level, denoted (S for Static) $\lambda_S^*(\sigma, \gamma)$, depends on both accuracy parameters: the one for the quality of detection, σ, and the one for the quality of trial, γ.

It is straightforward to see that a higher γ increases the threshold $\lambda_S^*(\sigma, \gamma)$: the accuracy of the trial lowers the cost of litigation, thus making the strict enforcement optimal more often.

In contrast, the accuracy of detection (σ) has an ambiguous impact in terms of optimal procedural choice. On the one hand, a more accurate detection allows the CA to better screen from the beginning the true type of the practice. This reduces

decision errors and increases the benefit of proposing commitments, since they will avoid costly litigation. This will strengthen the detection effect, and thereby favor the flexible enforcement. But on the other hand, a more accurate detection lowers the expected profit of type A and thus decreases the share of this type facing the CA. But this decline in the share of type A is relatively larger under strict rather than under flexible enforcement, because type A would more often pay the fine if litigation were imposed. This strengthens the deterrence effect of the strict enforcement, and thus increases its expected benefit.

Finally, note that a higher fine, hence a stronger deterrence through litigation, amplifies the impact of a more accurate detection on the deterrence effect. As a result, depending on the level of monetary sanction incurred in case of conviction (the fine f), two regimes must be considered for the impact of the accuracy of detection (σ). Either the monetary penalty is high, and then the better detection (higher σ) will favor the strict enforcement thanks to the increased deterrence - we call this "strong deterrence" regime. Or, on the contrary, if the fine is low, the resulting deterrence effect of litigation is quite low too, and hence the more accurate detection will favor instead the commitments offer (i.e. the flexible enforcement). We call this "weak deterrence" regime.[20]

Next we summarize the outcome of the welfare comparison between the strict and flexible enforcement (see proof in the Appendix):

Proposition 1 *The flexible enforcement is optimal iff the litigation cost is high enough ($\lambda > \lambda_S^*(\sigma, \gamma)$). The critical threshold $\lambda_S^*(\sigma, \gamma)$ is always increasing with γ, but increasing with σ iff the fine f is high enough.*

[20] In particular, we should note that a fine equal to the expected extra profit from an anticompetitive practice is sufficient to ensure a strong deterrence regime. But if the probability σ is low, such a fine may need to be very high.

Proposition 1 clarifies that the choice between the strict and flexible enforcement depends on the litigation cost. The critical value of the latter depends in its turn on the accuracy of both detection and trial. A higher trial accuracy will naturally favor the strict enforcement (i.e. imposing litigation). In contrast, the impact of the detection accuracy on the optimal enforcement, strict or flexible, depends on the deterrence achieved when imposing litigation. The monetary penalty in case of conviction upon trial is crucial for the deterrent effect of litigation, and eventually signs the impact of the accuracy of detection on the choice of optimal enforcement. This result is important because it allows to compare the informational benefit of a more accurate detection between the two enforcement regimes: a more accurate detection is more valuable with strict enforcement only if the deterrence derived from the monetary penalty is high enough. This result will play a key role when we consider the dynamic impact of the choice between litigation and commitments, which we do next.

4.2 The dynamic case and the learning effect

We now examine each type of enforcement when the CA's procedural choice takes into account the learning effect of present litigation on future enforcement. For this, we consider a two-period setting ($t = 1$ and $t = 2$) where the previous game is repeated twice. It has been established (Proposition 1) that in a static context, there is a strong bias toward commitments in case of flexible enforcement. The pending question is whether such a future bias at period 2 is likely to provide additional inefficient incentives to adopt commitments at the first period, if the flexible enforcement is adopted. To answer this, we contrast the procedural choice made by the CA at $t = 1$ in two different cases:

- the flexible enforcement in the dynamic case: the flexible enforcement is used at both periods.

- the optimal enforcement in the dynamic case: the CA determines the optimal enforcement for each period.

4.2.1 The flexible enforcement in the dynamic case

The game is displayed in Figure 3 below:

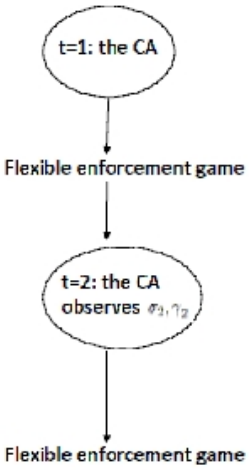

Fig.3

We allow the values of parameters σ and γ to be different at $t = 2$ from $t = 1$, depending on the procedure chosen at $t = 1$. The following table explains this, and captures the learning effect of litigation at $t = 1$:[21]

$t = 1$	$t = 2$
$\underline{\sigma}$ and $\underline{\gamma}$	$\overline{\sigma} > \underline{\sigma}$ and $\overline{\gamma} > \underline{\gamma}$ if conclusive trial at $t = 1$ $\underline{\sigma}$ and $\underline{\gamma}$ if no trial or inconclusive trial at $t = 1$

[21] Learning requires knowledge on the case. The mere fact that a type A accepts commitments is not sufficient to increase the accuracy of future assessment because there is no production of knowledge.

The CA maximizes the sum of the expected welfare net of the social litigation cost at each period.[22] This objective function preserves the agency's choice from any exogenous bias, since the CA will perfectly internalize the effect of a present decision on future welfare.

We now determine the PBE of the whole game with two periods in the following lemma:

Lemma 2 *With flexible enforcement in the dynamic case, litigation is the equilibrium procedural choice at the first period iff* $\lambda < \lambda_D \equiv \frac{\Delta W^{Com}}{W^A}$, *where* $\Delta W^{Com} = \underline{\gamma}\left(W^{Com}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma})\right)$.

Explicitly, for litigation to be chosen at the first period, the total relative cost of litigation incurred by the CA at the time of the procedural choice (λ), must now be compensated by the future relative benefit of present-period litigation, given by $\underline{\gamma}\left(W^{Com}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma})\right)$. The first period procedural choice may be interpreted as an investment decision that requires a cost λ at period 1, and yields a future benefit through an increase in the future detection accuracy. Note that the future benefit is measured taking into account the second period procedural choice, i.e. commitments.

We then compare that threshold λ_D (D for dynamics), which dictates the adoption of litigation at $t = 1$ if flexible enforcement is used at $t = 2$, with the corresponding threshold in case of optimal enforcement. In doing so, we examine whether the learning dynamic effect magnifies or lessens the previously identified over-incentives toward commitments under flexible enforcement.

4.2.2 The optimal enforcement in the dynamic case

We consider the following game (see Figure 4 below), where:

[22] This amounts to assuming that the discount factor is equal to 1.

at $t = 1$: the CA chooses between the flexible enforcement and the strict enforcement

at $t = 2$: the CA observes σ_2 and γ_2 and chooses between the flexible enforcement and the strict enforcement.

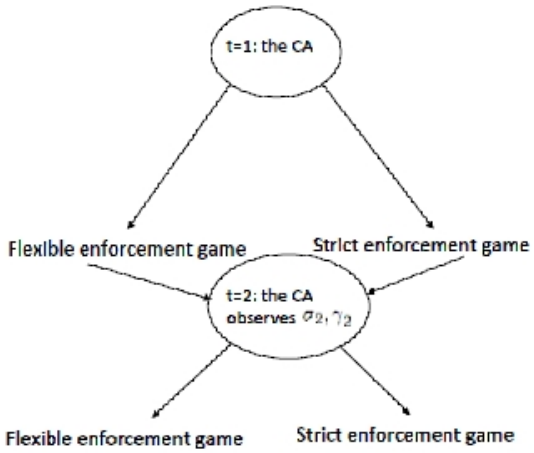

Fig.4

The objective of the CA is to maximize the sum of the expected welfare net of the social litigation cost.

We solve this game backwards[23] by determining first the optimal enforcement at

[23] At this point there is an important remark to make on the resolution of the optimal enforcement game. We consider here that the CA determines the optimal enforcement at each period. We could have instead allowed the CA to choose the optimal enforcement for both periods at $t = 1$. This would have led to the same result because there is no benefit to distort the enforcement choice at $t = 2$ in order to influence the CA strategy at $t = 1$. The only decision that may be influenced at $t = 1$ is the choice between commitments and litigation (under flexible enforcement) towards commitments, since the CA can always impose litigation. But, we showed that there is a static over-incentive to choose commitments. Thus, there is no benefit to further increase this incentive by distorting the enforcement choice at $t = 2$ in order to favor the commitments choice at $t = 1$ under the flexible enforcement. As a result, the optimal enforcement for $t = 2$ is the same whatever the period at which this enforcement is chosen ($t = 1$ or $t = 2$).

$t = 2$ according to (σ_2, γ_2). We then identify the optimal enforcement at the first period taking into account the optimal enforcement chosen at $t = 2$. We derive the following result (see proof in the Appendix):

Lemma 3 *If the optimal enforcement is adopted at the second period, then strict enforcement is optimal at the first period iff:*

$$\lambda < \lambda_D^* = \underbrace{\frac{(1-\underline{\sigma})}{\underline{\sigma}}\left[(1-G(\widehat{c}))\frac{a^{Com}}{(a^{Com}-a^{Lit})}-1\right]^{-1}}_{static\ effect=\lambda_S^*(\underline{\sigma},\underline{\gamma})} + \underbrace{\frac{\underline{\gamma}}{W^A}\left[W^{Opt}(\overline{\sigma},\overline{\gamma})-W^{Opt}(\underline{\sigma},\underline{\gamma})\right]}_{dynamic\ effect=\Delta W^{Opt}},$$

where $W^{Opt}(\sigma, \gamma)$ is the expected welfare from the optimal procedure at $t = 2$ depending on the level of γ and σ at $t = 2$.

Lemma 3 indicates that the optimal enforcement choice at $t = 1$ is driven by the level of litigation cost, λ, relative to a critical threshold denoted λ_D^*.

The threshold λ_D^* has two components: one due to the "static effect" of strict enforcement, already present in expression (2). The second component is due to the "dynamic effect" of the present procedural choice on future expected welfare. This dynamic impact is driven by the application of future optimal enforcement and not by the commitments procedure as in the case of flexible enforcement. It is easy to show that $\Delta W^{Opt} = \underline{\gamma}\left[W^{Opt}(\overline{\sigma},\overline{\gamma}) - W^{Opt}(\underline{\sigma},\underline{\gamma})\right] > 0$, because the increase in γ and σ improves the expected welfare (see the Appendix). This means that the dynamic cost threshold for optimally choosing litigation (λ_D^*) exceeds the critical threshold identified in Proposition 1, $\lambda_S^*(\underline{\sigma}, \underline{\gamma})$, if the dynamic effect of litigation is ignored. The reason is that the litigation procedure yields future benefits: the improved future detection and litigation accuracy. These benefits logically lead the CA to optimally prefer the strict enforcement for a higher litigation cost. It implies that for $\lambda < \lambda_S^*(\underline{\sigma}, \underline{\gamma})$, the strict enforcement is optimal at the first period. We then focus on values of λ such that $\lambda > \lambda_S^*(\underline{\sigma}, \underline{\gamma})$.

4.2.3 The flexible vs optimal enforcement in the dynamic case

If the dynamic effect is ignored, the commitments are inefficiently proposed under flexible enforcement for λ in $[0, \lambda_S^*(\underline{\sigma}, \underline{s})]$. Taking into account the dynamic effect will magnify this bias iff this inefficiency-prone range of λ expands: $[\lambda_D^* - \lambda_D] > [\lambda_S^*(\underline{\sigma}, \underline{s})]$. Hence, to identify this possible additional bias toward commitments at the first period, we need to compare λ_D^* and λ_D. For that, it is necessary to weigh the dynamic consequences of increasing both detection and litigation accuracy, so as to determine whether the future flexible enforcement is likely to strengthen the static bias against litigation in case of flexible enforcement at the present period, or if instead, the future flexible enforcement alleviates this static bias. The following lemma provides the outcome of this comparison:

Lemma 4 *Under strong deterrence, we have:*

(i) If $\lambda > \lambda_S^*(\overline{\sigma}, \overline{\gamma})$, *then* $\Delta W^{Opt} = \Delta W^{Com}$;

(ii) If $\lambda_S^*(\underline{\sigma}, \underline{\gamma}) < \lambda < \lambda_S^*(\overline{\sigma}, \overline{\gamma})$, *then* $\Delta W^{Opt} = \underline{\gamma}\left(W^{Lit}(\overline{\sigma}, \overline{\gamma}) - W^{Com}(\underline{\sigma}, \underline{\gamma})\right) > \Delta W^{Com}$.

Under weak deterrence, for all $\lambda > \lambda_S^*(\underline{\sigma}, \underline{\gamma})$ *we have* $\Delta W^{Opt} = \Delta W^{Com}$.

Starting with the strong deterrence case, we first (i) consider the high litigation cost (i.e. when $\lambda > \lambda_S^*(\overline{\sigma}, \overline{\gamma})$), where commitments are optimal at the second period. In this case, the source of inefficiency is purely static, and was already identified before. It is only the static bias that leads the CA to undervalue the benefit of imposing litigation: $\lambda_D^* - \lambda_D = \lambda_S^*(\underline{\sigma}, \underline{\gamma})$. There is no dynamic inefficiency, because at $t = 2$ commitments (which are chosen in equilibrium under the flexible enforcement) are also optimal.

The second possible subcase with strong deterrence, (ii), is that of an intermediate level of litigation cost: $\lambda_S^*(\underline{\sigma}, \underline{\gamma}) < \lambda < \lambda_S^*(\overline{\sigma}, \overline{\gamma})$. Here, the optimal choice at $t = 2$ depends on the accuracy of detection: if the latter is high following conclusive litigation

at $t = 1$, then, under strong deterrence, it is optimal to impose litigation at $t = 2$, whereas if it remains low, it is better to allow for commitments at $t = 2$. Hence, the CA's under-incentives to impose litigation in subcase (ii) are partly due to the inefficient choice at $t = 2$: with strong deterrence, a better detection makes litigation relatively more efficient, therefore the sub-optimal choice at $t = 2$ leads the CA to undervalue the benefit of litigation at $t = 1$ (since $\Delta W^{Opt} > \Delta W^{Com}$). Here the dynamic benefit of litigation strengthens the CA's under-incentives to impose litigation: $\lambda_D^* - \lambda_D > \lambda_S^*(\underline{\sigma}, \underline{\gamma})$.

Turning now to the weak deterrence regime, the same outcome prevails as in subcase (i) above, where the inefficiency is only static, since at $t = 2$ commitments are optimal and also chosen in equilibrium under flexible enforcement. This does not come as a surprise given that with weak deterrence, the improved detection comforts the optimality of commitments.

To sum up, and in line with the interpretation of the choice of enforcement as an investment in future detection accuracy, we find that the flexible enforcement leads to a miscalculation of this investment cost, which always gets to be over-estimated because the deterrence effect of the choice made at the present period is not considered. In addition, there is also an under-estimation of the future benefit from the higher detection accuracy whenever the CA can easily deter the anticompetitive behavior (i.e. when the strong deterrence regime holds).

Below we summarize these result in terms of the incentives for the CA to adopt litigation at the first period:

Proposition 2 *(1) In the dynamic case, the flexible enforcement leads to an over-incentive to propose commitments at the first period as compared with the optimal enforcement (for $\lambda \in [\lambda_D, \lambda_D^*]$).*

(2) The CA undervalues the learning benefit of the Litigation procedure iff the mon-

etary penalty upon trial conviction is deterrent enough, i.e. when the strong deterrence regime applies.

Proposition 2 has two implications.

First, for an intermediate level of litigation costs, the CA does not choose to enforce the Litigation procedure in equilibrium, so it should be imposed because it is the optimal option under optimal enforcement in the dynamic case.

Second, the inefficient use of the commitment procedure typically occurs when the anticompetitive practice is strongly deterred. In this case, the CA's sub-optimal equilibrium choice at $t = 2$ to not impose litigation will comfort her sub-optimal choice at $t = 1$ to not litigate: the future static inefficiency triggers dynamic inefficiency. More precisely, the fact that the CA will not litigate tomorrow reduces her incentives to impose litigation today. To see this, recall that with strong deterrence, a better detection accuracy makes welfare benefit of litigation higher than offering commitments. As a result, given that at $t = 2$ the CA will always choose commitments in equilibrium, the future benefit of a trial at the present period is lower than if the CA imposed litigation at $t = 2$. In other words, the CA's over-incentives to propose commitments tomorrow makes her undervalue the benefit to impose litigation today: tomorrow's static inefficiency creates present dynamic inefficiency. In short, a given period's bias toward commitments gives rise to a dynamic bias toward commitments.

5 Conclusion and final remarks

This paper discussed the optimal use of commitments in antitrust. We consider two alternative proceedings that the agency can use to dispose of a case, either by litigation or by offering commitments, and conduct a comparison between two different enforcement regimes, one where the agency always imposes litigation and one where

the agency chooses between litigation and commitments. In a purely static setting we identify a first inefficiency affecting the optimal enforcement choice: the CA undervalues the benefit of litigation and therefore imposes trial in equilibrium less often than it is optimal. In a dynamic setting, allowing for increased accuracy of detection and adjudication following a conclusive trial, we find that the above-mentioned inefficiency may lead the CA to overlook the dynamic benefit of litigation, depending on the strength of deterrence effect associated with the better detection of the practice. This shows the need to factor in the deterrence exerted by the antitrust enforcement when assessing the true benefit of a commitments procedure.

Our analysis suggests that a flexible antitrust enforcement that allows for commitments proceedings has potentially a cumulative and self-reinforcing effect over time, since the future CA's decision to favor commitments is a source of an even stronger such bias at the present period. In short, the agency has under-incentives to reduce future uncertainty via judicial learning due to future sub-optimal enforcement. This outcome hinges on the strength of the deterrence effect associated with the future trial and detection of anticompetitive practices. So the direct policy implication is that commitments are not optimal when the antitrust enforcement achieves substantial deterrence of anticompetitive practices, and even more so when the dynamic benefit of litigation is considered.

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6 Appendix

6.1 Proofs

Proof of Lemma 1. In order to determine the Perfect Bayesian Equilibrium, we start first with the firm's choice when offered commitments:

Type P chooses litigation over commitments iff $\pi^P - c > 0$. This is always the case, by assumption, so type P always chooses litigation and refuses commitments.

Type A chooses litigation over commitments iff $(1-\gamma)\pi^A - c - \gamma f > 0$, i.e. $c < (1-\gamma)\pi^A - \gamma f = \widehat{c}$. Thus type A refuses commitments iff $c < \widehat{c}$.

There exists a unique equilibrium where the CA chooses the commitments procedure. To show this, we compare the expected welfare if the CA offers commitments, which is $\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}(W^P - T) - \frac{\sigma a G(\widehat{c})}{\sigma a+(1-\sigma)p}((1-\gamma)W^A + T)$, with the expected welfare if the CA imposes litigation, which is $-T + \left(\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}W^P - \frac{\sigma a(1-\gamma)}{\sigma a+(1-\sigma)p}W^A\right)$. Because $a^{Com} = F\left[(1-\sigma)\pi^A + \sigma\int_0^{\widehat{c}}((1-\gamma)\pi^A - c - \gamma f)g(c)dc\right] > 0$

and $a^{Lit} = F\left[(1-\sigma)\pi^A + \sigma((1-\gamma)\pi^A - \int_0^{\overline{c}} cg(c)dc - \gamma f)\right] \geq 0$, we always have $a \geq 0$ and thus, it always holds that $\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}(W^P - T) - \frac{\sigma a G(\widehat{c})}{\sigma a+(1-\sigma)p}((1-\gamma)W^A + T) \geq -T + \left(\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}W^P - \frac{\sigma a(1-\gamma)}{\sigma a+(1-\sigma)p}W^A\right)$.

■

Proof of Proposition 1. We determine here the optimal procedural choice between the strict and the flexible enforcement (we omit (σ, γ) in the notation of a^{Lit}, a^{Com}, p^{Lit} and p^{Com}). For this we need to compare the corresponding ex ante expected welfare levels:

- under strict enforcement: $W^{Lit}(\sigma,\gamma) = \frac{1}{2}p^{Lit}\left[W^P - (1-\sigma)T\right]$

$-\frac{1}{2}a^{Lit}\left[(1-\sigma)W^A + \sigma((1-\gamma)W^A + T)\right]$;

- under flexible enforcement: $W^{Com}(\sigma,\gamma) = \frac{1}{2}p^{Com}\left[W^P - (1-\sigma)T\right]$

$-\frac{1}{2}a^{Com}\left[(1-\sigma)W^A + \sigma G(\widehat{c})((1-\gamma)W^A + T\right]$.

The difference between the two writes:

$W^{Com}(\sigma,\gamma) - W^{Lit}(\sigma,\gamma)$

$= -\frac{1}{2}\sigma\left(T + (1-\gamma)W^A\right)(G(\widehat{c})a^{Com} - a^{Lit}) - \frac{1}{2}(1-\sigma)(a^{Com} - a^{Lit})W^A$.

We then consider only the case where $(G(\widehat{c})a^{Com} - a^{Lit}) < 0$. Otherwise, litigation is always optimal (that may be the case, in particular, if f is high enough):

we have that $W^{Com}(\sigma,\gamma) - W^{Lit}(\sigma,\gamma) > 0$ iff: $\frac{T+(1-\gamma)W^A}{W^A} = \lambda >$
$\left[\frac{\sigma}{1-\sigma}.\frac{-\int_{\widehat{c}}^{\overline{c}}\left(\gamma f+c-(1-\gamma)\pi^A\right)g(c)dc+(1-G(\widehat{c}))\int_0^{\widehat{c}}\left((1-\gamma)\pi^A-c-\gamma f\right)g(c)dc}{\int_{\widehat{c}}^{\overline{c}}(\gamma f+c-(1-\gamma)\pi^A)g(c)dc} + \frac{(1-G(\widehat{c}))\pi^A}{\int_{\widehat{c}}^{\overline{c}}(\gamma f+c-(1-\gamma)\pi^A)g(c)dc}\right]^{-1}$
$= \left[\frac{\sigma}{1-\sigma}A + B\right]^{-1} \equiv \lambda_S^*(\gamma,\sigma)$, with $B > 0$.

The sign of A depends in particular on the level of f. We have $\frac{\partial A}{\partial f} < 0$. It follows that if f is high enough, then it is possible to have $A < 0$. Thus the critical threshold $\lambda_S^*(\gamma,\sigma)$ increases with σ iff $A < 0$.

In addition, if γ increases, $\left[\frac{\sigma}{1-\sigma}A + B\right]^{-1}$ increases too, therefore $\lambda_S^*(\gamma,\sigma)$ increases with γ.

■

Proof of Lemma 2. *The flexible enforcement in the dynamic case*

The procedural choice at $t = 2$ is always commitments, as described by Lemma 1.

The procedural choice at $t = 1$ is driven by a welfare comparison at stage 2 of period 1:

If the CA imposes litigation, the expected welfare is equal to
$\frac{p(1-\underline{\sigma})}{p(1-\underline{\sigma})+a\underline{\sigma}}W^P - \frac{a\underline{\sigma}}{p(1-\underline{\sigma})+a\underline{\sigma}}(1-\underline{\gamma})W^A - T + \left[\underline{\gamma}W^{Com}(\overline{\sigma},\overline{\gamma}) + (1-\underline{\gamma})W^{Com}(\underline{\sigma},\underline{\gamma})\right]$,
If the CA decides to offer commitments, the expected welfare becomes
$\frac{(1-\underline{\sigma})p}{(1-\underline{\sigma})p+\underline{\sigma}a}\left[W^P - T + \underline{\gamma}W^{Com}(\overline{\sigma},\overline{\gamma}) + (1-\underline{\gamma})W^{Com}(\underline{\sigma},\underline{\gamma})\right]$
$+\frac{\underline{\sigma}a}{(1-\underline{\sigma})p+\underline{\sigma}a}\left[\begin{array}{c} G(\widehat{c})\left(-(1-\underline{\gamma})W^A - T + \underline{\gamma}W^{Com}(\overline{\sigma},\overline{\gamma}) + (1-\underline{\gamma})W^{Com}(\underline{\sigma},\underline{\gamma})\right) \\ +(1-G(\widehat{c}))W^{Com}(\underline{\sigma},\underline{\gamma}) \end{array}\right]$.
where we denote by a and p the beliefs that type A and type P respectively have adopted the practice at $t = 1$.

The comparison of the two expected welfare expressions shows that litigation is the equilibrium procedural choice at the first period iff the following condition is satisfied: $\frac{(1-\underline{\gamma})W^A+T}{W^A} < \frac{\Delta W^{Com}}{W^A} \equiv \lambda_D$, with $\Delta W^{Com} = \underline{\gamma}\left(W^{Com}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma})\right)$.

This condition does not depend either on a or on p. Thus the CA chooses the commitments procedure iff $\lambda > \lambda_D$. ■

Proof of Lemma 3. *The optimal enforcement in the dynamic case*

Strict enforcement at $t = 1$ (litigation imposed at $t = 1$) :

The expected welfare is given by:

$\frac{1}{2}pW^P - \frac{1}{2}W^A a^{Lit}((1-\gamma)\underline{\sigma} + (1-\underline{\sigma})) - \frac{1}{2}(p(1-\underline{\sigma}) + a^{Lit}\underline{\sigma})T +$

$Q^{Lit}\left[W^{Opt}(\overline{\sigma},\overline{\gamma})\right] + (1-Q^{Lit})\left[W^{Opt}(\underline{\sigma},\underline{\gamma})\right],$

where Q^{Lit} denotes the probability of conclusive litigation at $t = 1$ under procedure *Lit* and where $W^{Opt}(\sigma,\gamma)$ is the expected welfare when the CA determines the optimal enforcement at $t = 2$ according to the level of parameters γ and σ. We have $Q^{Lit} = \frac{1}{2}\underline{\sigma}\underline{\gamma}a^{Lit} + \frac{1}{2}(1-\underline{\sigma})\underline{\gamma}p$ and also $p = p^{Lit} = p^{Com}$.

Flexible enforcement at $t = 1$:

Following Lemma 2, commitments are offered iff $\lambda > \frac{\Delta W^{Opt}}{W^A}$.

Then, in this case (i.e. when commitments are offered), the expected welfare is given by:

$\frac{1}{2}pW^P - \frac{1}{2}W^A a^{Com}((1-\underline{\gamma})\underline{\sigma}G(\widehat{c}) + (1-\underline{\sigma})) - \frac{1}{2}(p(1-\underline{\sigma}) + a^{Com}G(\widehat{c})\underline{\sigma})T +$

$Q^{Com.}\left[W^{Opt}(\overline{\sigma},\overline{\gamma})\right] + (1-Q^{Com})\left[W^{Opt}(\underline{\sigma},\underline{\gamma})\right],$

where Q^{Com} denotes the probability of conclusive litigation at $t = 1$ under procedure *Com*. We have that $Q^{Com} = \frac{1}{2}\underline{\sigma}\underline{\gamma}G(\widehat{c})a^{Com} + \frac{1}{2}(1-\underline{\sigma})\underline{\gamma}p$ and also $p = p^{Lit} = p^{Com}$.

Then, the strict enforcement (litigation imposed) is optimal at $t = 1$ iff:

$\lambda < \frac{(1-\underline{\sigma})}{\underline{\sigma}}\left[(1-G(\widehat{c}))\frac{a^{Com}}{(a^{Com}-a^{Lit})} - 1\right]^{-1} + \frac{1}{W^A}\underline{\gamma}\left[W^{Opt}(\overline{\sigma},\overline{\gamma}) - W^{Opt}(\underline{\sigma},\underline{\gamma})\right] = \lambda_D^*$ with $\lambda_D^* > \frac{\Delta W^{Opt}}{W^A}$. ■

Proof of Lemma 4 and Proposition 2. From Proposition 1, we have:

Strong deterrence ($\lambda_S^*(\underline{\sigma},\underline{\gamma}) < \lambda_S^*(\overline{\sigma},\overline{\gamma})$)

(i) for $\lambda > \lambda_S^*(\overline{\sigma},\overline{\gamma})$, then $W^{Opt}(\overline{\sigma},\overline{\gamma}) - W^{Opt}(\underline{\sigma},\underline{\gamma}) = W^{Com}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma})$

In this case we have $\lambda_D^* - \lambda_D = \lambda_S^*(\underline{\sigma},\underline{\gamma})$

(ii) for $\lambda_S^*(\underline{\sigma},\underline{\gamma}) < \lambda < \lambda_S^*(\overline{\sigma},\overline{\gamma})$, $W^{Opt}(\overline{\sigma},\overline{\gamma}) - W^{Opt}(\underline{\sigma},\underline{\gamma}) = W^{Lit}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma})$

In this case we have $W^{Opt}(\overline{\sigma},\overline{\gamma}) - W^{Opt}(\underline{\sigma},\underline{\gamma}) = W^{Lit}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma}) > W^{Com}(\overline{\sigma},\overline{\gamma}) -$

$W^{Com}(\underline{\sigma},\underline{\gamma})$. Thus $\lambda_D^* - \lambda_D > \lambda_S^*(\underline{\sigma},\underline{\gamma})$

Weak deterrence ($\lambda_S^*(\underline{\sigma},\underline{\gamma}) > \lambda_S^*(\overline{\sigma},\overline{\gamma})$)

For $\lambda > \lambda_S^*(\underline{\sigma},\underline{\gamma})$, then $W^{Opt}(\overline{\sigma},\overline{\gamma}) - W^{Opt}(\underline{\sigma},\underline{\gamma}) = W^{Com}(\overline{\sigma},\overline{\gamma}) - W^{Com}(\underline{\sigma},\underline{\gamma})$

In this case we have $\lambda_D^* - \lambda_D = \lambda_S^*(\underline{\sigma},\underline{\gamma})$.

For $\lambda_D^* < \lambda < \lambda_D$, commitments are proposed at $t = 1$ in case of flexible enforcement at $t = 2$, while it is optimal to impose litigation at $t = 1$ if the optimal enforcement is chosen at $t = 2$. ■

6.2 Discussion

6.2.1 The CA's decision to start litigation proceedings if it gathers evidence

We briefly discuss here the CA's options when it gathers evidence that the firm's conduct is anticompetitive: the CA may either start litigation or not.

In case of pure *laissez faire*, the expected welfare is equal to $-W^A\frac{1}{2}F(\pi^A) + \frac{1}{2}W^P F(\pi^P)$.

Laissez faire is dominated iff $Max(W^{Lit}(\sigma,\gamma), W^{Com}(\sigma,\gamma)) \geq -W^A\frac{1}{2}F(\pi^A) + W^P F(\pi^P)$.

This inequality is satisfied as long as the legal costs c and T are low enough.

6.2.2 The CA's decision to impose trial in case of firms' refusal of commitments

In case of flexible enforcement, we assume that the CA commits to go to trial if the firm does not accept commitments. We justify below this assumption.

First, as long as the expected welfare is positive after Bayesian revision, then the decision to impose litigation is credible even after the firm's decision to refuse commitments. This is the case iff $-(1-\gamma)\frac{a\sigma G(\widehat{c})}{a\sigma G(\widehat{c})+p(1-\sigma)}W^A + \frac{p(1-\sigma)}{a\sigma G(\widehat{c})+p(1-\sigma)}W^P - T >$

$-\frac{a\sigma G(\widehat{c})}{a\sigma G(\widehat{c})+p(1-\sigma)}W^A + \frac{p(1-\sigma)}{a\sigma G(\widehat{c})+p(1-\sigma)}W^P$.

This is true as long as $G(\widehat{c})$ is high enough or the trial efficient enough with low T and high γ.

In the other cases, we show that the CA commitment is optimal from the CA perspective: if we allow the CA to choose between "commit" or "no commit", it is always better for the CA to commit.

We consider the case where the CA does not want to go to trial if the firm does not accept the commitments. In the absence of the CA's commitment to go to trial, the only possible equilibrium is one where the CA mixes between trial with probability β and no trial with probability $1-\beta$.

In equilibrium, this mixed strategy imposes the same expected welfare in both cases, trial and no trial:

$-(1-\gamma)\frac{a\sigma G(\widehat{c})}{a\sigma G(\widehat{c})+p(1-\sigma)}W^A+\frac{p(1-\sigma)}{a\sigma G(\widehat{c})+p(1-\sigma)}W^P-T = -\frac{a\sigma G(\widehat{c})}{a\sigma G(\widehat{c})+p(1-\sigma)}W^A+\frac{p(1-\sigma)}{a\sigma G(\widehat{c})+p(1-\sigma)}W^P$.

On the firm side, the firm that observes a litigation cost $\widehat{c}$ must be indifferent between proposing commitments and not proposing commitments, which is the case iff:

$0 = \left(-\widehat{c} - \gamma f + (1-\gamma)\pi^A\right)\beta + (1-\beta)\pi^A$

Therefore, if the CA commits to impose trial if the firm does not accept commitments, the firm does not accept commitments for a lower cost threshold $\widehat{c}' < \widehat{c}$. The induced expected welfare is thus:

$-(1-\gamma)\frac{a\sigma G(\widehat{c}')}{a\sigma G(\widehat{c}')+(1-\sigma)p}W^A + \frac{p(1-\sigma)}{a\sigma G(\widehat{c}')+(1-\sigma)p}W^P - T > -(1-\gamma)\frac{a\sigma G(\widehat{c})}{a\sigma G(\widehat{c}')+(1-\sigma)p}W^A + \frac{p(1-\sigma)}{a\sigma G(\widehat{c}')+(1-\sigma)p}W^P - T$.