Litigation and the Informational Value of Precedent: 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 by focusing on the role of precedent produced through formal litigation. Our framework allows to combine key effects in the same model: the deterrence of the primary behavior by the different procedural instruments (commitments or formal prohibitions), and the dynamic perspective through the focus on precedent production through trial. We show that if the level of penalty is high enough, the antitrust authorities undervalue the dynamic benefit of legal precedent and tend to overuse commitments.

Keywords: antitrust, commitments, deterrence, legal precedent

JEL classification: L41, K21, D82

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1 Introduction

More than five years after opening a case against Google, and two years after sending a statement of objections, "The European Commission fined Google €2.42 billion for breaching EU antitrust rules. 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" (Brussels, 27 June 2017 - IP 17/1784).[1] Albeit planning to enforce prohibitions whenever there is significant need for "deterrence, punishment and legal precedent"[2], the European Commission issued only very few prohibition decisions in novel areas of intervention for which legal guidance is much needed[3]. Instead, since the entering into force on May 1 2004 of the Council Regulation No 1/2003 making room for commitments as formal settlements, the European Commission has heavily relied on such decisions to deal with antitrust 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 (Marinielllo, 2014). In order to assess the opportunity and consequences of this policy trend, it is necessary to examine the underlying welfare trade-off between prohibitions and commitments decisions.

The key benefit of a commitments decision is to reduce social cost thanks to an earlier restoration of market competition at a lower administrative costs. In contrast, the main benefits from a prohibition decision are the deterrence through the enforcement of

[1] https://ec.europa.eu/commission/presscorner/detail/en/IP_17_1784

[2] 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.

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

sanctions, and the creation of legal precedents. Commitments do not formally identify a infringement, and the firms admit no wrongdoing.[4] This absence of identification of anticompetitive concerns does not create legal precedents and thus commitment decisions offer little guidance on how similar scenarios might be assessed by the agency in the future.[5] Two recent antitrust cases epitomize the implications of this lack of precedent. After opening the Hollywood Studios/Pay-TV case against the major US studios and Sky UK for geoblocking agreements in 2015, the EC finally closed it in 2019 after all investigated parties had offered commitments. At the same time, the main legal question raised by the case (copyright infringement and parallel trade within the common European market) is left unresolved.[6] By the same token, 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.[7] Incidentally, this was a declaratory decision without fines: the EC had already in the past chosen to impose no fines or only symbolic ones when the conduct sanctioned by the formal decision had taken place at a time where the law was unclear.

In this paper we address the question of how a forward looking and benevolent competition authority (CA henceforth) may correctly assess the present and future costs and benefits of using commitments rather than pronouncing a formal prohibition

[4] "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).

[5] "(B)ecause commitment decisions do not establish any legal precedent, they provide for little guidance on the interpretation of the law" (Mariniello, 2014).

[6] The only court decision available to date (T-873/16) is a ruling by the General Court on an appeal action brought by a third party to the case against the Art. 9 decision that made binding the commitments offered by one of the investigated parties, and does not represent a real precedent.

[7] Case 2014/C 344/06.

decision. From a static perspective, the commitments decision allows the CA to save on procedural and administrative costs, but it also reduces the deterrence effect of public enforcement by reducing the monetary penalty incurred by firms in case of alleged anticompetitive practices. From a dynamic perspective, the commitments do not allow the creation of precedent, and thus prevent a better identification and assessment of similar practices in the future, whereas legal precedents have informational value, since past decisions provide useful information and thus make future decisions more accurate.[8] As a result, the future deterrence effect of antitrust will not be enhanced in the absence of precedents. The main question we address is to what extent a benevolent and forward-looking CA internalizes both static and dynamic costs-benefit trade-offs of the commitments procedure.

For this purpose we contrast two institutional arrangements. According to the first enforcement option, the antitrust authority does not propose a commitments procedure track to firms in order to fix the alleged anticompetitive behavior, but instead commits to always litigate the case. The second enforcement regime allows the CA to choose the procedure by either proposing commitments or imposing trial. We use a dynamic setting, where formal decisions (i.e. trial) allow the creation of precedent, and thus provide guidance for the assessment of future cases.

Our broad objective is to identify the social cost and benefit associated with a strict enforcement regime in which antitrust commitments are not available and therefore the antitrust agency always goes to trial. Equivalently, we assess the cost-benefit trade-off

[8] In the words of Spier (2007) page 298," the presence of earlier rulings on particular issues provides a reason for ruling in the same way when new cases arise with similar issues. [...] At first blush, adherence to the precedent set by earlier cases can create value for two reasons. First, past decisions embody useful information for future decision making, and so precedent will tend to lead to more accurate court decisions. (This is especially true if judges lack the expertise or the time to make accurate decisions in isolation.)"

of a flexible institutional framework in which the antitrust agency chooses between going to trial and offering commitments.

We start with a purely static analysis and show that the flexible enforcement leads the CA to propose too often commitments. Being able to choose between settlement and litigation leads the CA to neglect the higher deterrence effect of the strict enforcement regime (in which the CA commits to impose litigation), and focus instead only on the saving of trial costs following a commitment offer. In a dynamic setting where the procedural choice is made at each period, this static inefficiency leads the CA to undervalue or overvalue the informational benefit from a formal judicial decision as a source of legal precedent. This benefit is the increase in the accuracy of detection and adjudication in the future. The question we address is to what extent this static bias towards commitments may cause inefficiency by distorting the CA's assessment of a the future situations. We show that the deterrence achieved by the CA's detection activity is critical: a better future assessment has a higher welfare positive impact under the commitments procedure only if the deterrence is weak. This implies that if deterrence is stronger, the CA's bias in favor of commitments at a given period is a source of an even stronger such bias at the previous period. The policy implication of our results is that the flexible enforcement fosters excessive incentives to apply the commitments procedure when the antitrust enforcement produces substantial deterrence of anticompetitive practices. Instead, a weaker deterrence, due to lower fines in case of conviction for instance, will lower the opportunity cost of using the commitments procedure.

2 Related literature

Given our focus on trial proceedings as a source of precedent, our paper is related to the growing literature studying the creation of law through the formal decisions made

by a Court[9] and the role of learning in judicial decision-making. Baker and Mezzetti (2012) is a fitting recent example of dynamic model of judge-made law which highlights the information-based trade-off when disposing of a case. In their framework, the court must decide whether to summarily dispose of the case, or instead to conduct a costly investigation to learn the ideal outcome. The court balances between incurring adjudication costs and (potentially) deciding cases incorrectly.[10] With the unique exception of Parameswaran (2018), these models of law creation through trial typically assume that cases brought in front of the court are random draws, so the underlying agent behavior is not explored.[11] Our paper similarly considers an endogenous distribution of cases to be disposed of, by explicitly modelling the adoption of the potentially harmful conduct, and also by incorporating a detection activity on behalf of the agency that may initiate the trial proceedings. In other words we frame a public enforcement system, in contrast to most contributions addressing the creation of law through the formal decisions made by a Court in a private enforcement context.[12] This is due to the fact that our analysis of the value of precedent produced trough trial is actually designed to further the understanding of the trade-off between antitrust prohibitions and settlements, the latter being derived from commitment decisions. Only three other contributions have, to our knowledge, considered the antitrust enforcement and examined this trade-off.

[9] See Miceli (2008) or Gennaioli and Shleifer (2007) for instance.

[10] A similar trade-off is present in Anderlini et al. (2014), which considers a court of law that may be either constrained by precedents (which evolve according to a dynamic process) or unconstrained. In the latter case the court has complete discretion to either take a tough but costly, forward-looking decision, or a weak and less expensive, but myopic, one.

[11] In contrast, Parameswaran (2018) adds a case-generating process to the Baker and Mezzetti (2012) framework, to have the flow of cases heard by the judge actually be affected by the court's prior decisions.

[12] For an exception, see Polinsky and Rubinfeld (1989).

In a setting where the agency can commit beforehand on the probability to offer commitments, and where the firms have private information on the gain obtained from the anticompetitive conduct, Choné et al. (2014) shows that commitments may benefit consumers by avoiding the costly trial (less procedural delay and less uncertainty), while at the same time lowering the deterrence of the anticompetitive conduct. Gautier and Petit (2018) employ in contrast a framework with both asymmetric information (the firms have better information on the magnitude of the harm) and uncertainty (the firms do not know whether the infringement can be established as a matter of law) to highlight that the generalized use of antitrust commitments will likely trigger both over- and under-enforcement of competition law: over-enforcement because the agency sometimes applies remedies to non-cases, but also under-enforcement because remedies are lower compared to those imposed under the formal decision. Finally, Polo and Rey (2016) propose instead a signalling model to show that commitments have an anticompetitive effect of softening deterrence, but also a pro-competitive effect of making prosecution more effective. As a result, commitments 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.

Our analysis shares some common features with these papers that build on the literature on settlement and plea bargaining[13]: the asymmetric information setting, the trade-off between the avoidance of costly litigation on the one hand and the lower deterrence on the other, and the public enforcement standpoint. But our model also features some crucial differences from these three contributions. To start with, the one-shot game in our paper allows for the firms' endogenous behavior (which is absent from Gautier and Petit (2018)), as well as the endogenous enforcement policy (in contrast to Choné et al. (2014) whose agency commits in advance to a particular enforcement

[13]See Daughety and Reinganum (2011) for a recent survey.

policy) and also the detection ability of the agency (which is missing from Polo and Rey (2016)). The latter will be the crucial parameter in our dynamic, two-stage game, since it will likely be affected by the existence of legal precedents.

3 The model

The players and their information

A firm may adopt or not a given practice, which can be either pro- or anticompetitive. This is observed by the firm. We denote 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. 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 π, which is distributed according to the cdf $G(x)$ over the interval $[\underline{\pi}, +\infty]$. The profit increase is firm's private information. The profit increase is a mere transfer between firms within the industry, and is assumed to be the same for both types of practice. This is not the case for the welfare effect : the practice of type A has an external negative welfare impact equal to $-W < 0$, while the practice of type P has an external positive welfare impact of $W > 0$. The adoption of the practice is public information, but the type of the firm is private information.[14]

The antitrust enforcement

The agency observes the adoption of the conduct (but not its type) before starting an investigation to gather evidence. Based on that evidence, the CA concludes whether

[14]For instance, the defendant has established exclusive contracts with retailers (i.e. the practice), but the true effect of these contracts (purely exclusionary versus efficiencies thanks to exclusivity) is private information.

the practice raises serious anticompetitive concerns or not. At this stage, the CA may be wrong in its assessment of the true nature of the practice. Formally, the CA observes a signal (*Anticompetitive* or *Pro-competitive)* imperfectly correlated with the true type of the firm. We consider the following assumption: Prob(*Anticompetitive/A*) $= \sigma =$ Prob(*Pro-competitive/P*) and Prob(*Anticompetitive/P*) $= 1 - \sigma =$ Prob(*Pro-competitive/A*) with $\sigma > \frac{1}{2}$. Parameter σ captures the detection accuracy of the CA's investigation. Consequently, the probability that the CA considers the practice to be harmful equals σ for type A, but is equal to $(1 - \sigma)$ for type P.

Two different proceedings are available to dispose of a case.

The procedure labelled **Lit** requires the CA to establish a formal Statement of Objections (SO henceforth) for the final decision. Formally, we take this to be the infringement proceedings specified by Article 7 of the European antitrust regulation.[15] This is a long and adversarial process, whose final decision may be appealed. We capture this by assuming that there is a trial between the CA and the firm. The trial leads to a total social cost of T, which includes both the legal and opportunity cost for the CA as well as the legal cost incurred by the firm, whatever its type, denoted by c. We assume that the trial allows to discover the true nature of the practice with probability $s > \frac{1}{2}$. When convicted upon trial, type A must stop the practice and pay a monetary transfer (typically a fine). We denote f the monetary penalty incurred upon conviction, and assume that $\frac{1}{2}\underline{\pi} - \frac{1}{2}f > c$, meaning that in case of an informative trial, the litigation cost c and the fine are not high enough to deter a firm of type P from going to trial.

The second procedure, labelled **Com**, allows the CA to negotiate commitments with the firm, and mirrors the proceedings of article 9 of the European antitrust regulation. In our model, we summarize this settlement process by a commitments offer made by

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

the CA that the firm may accept or not. In case of refusal by the firm, the CA switches to the formal decision process described above: it will send a SO to the judge and the trial occurs. The commitments consist in abandoning the practice: therefore 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 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. Thus, when faced next with a similar practice, the CA as well as the judge will be better informed. In other words, in case of trial at date t, and of similar practice at date $t+1$, the probabilities σ and s increase. In short, the legal precedent allows both the CA and the judge to be more accurate in the future.[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.

The timing of the game with "strict enforcement":

At each period[17] t

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

Stage 2 - The CA (imperfectly) detects the practice.

Stage 3 - The CA enforces the specified procedure (**Lit**): trial occurs.

[16] We adopt here the informationnal view of legal precedents following Spier (2007), p. 298.

[17] The discunt factor is assumed to be equal to 1.

The timing of the game with "flexible enforcement":

At each period t

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

Stage 2 - The CA (imperfectly) detects the practice.

Stage 3 - The CA chooses the procedure to enforce: either **Com** or **Lit**.

Stage 4 - If procedure **Lit**, trial occurs. If procedure **Com**, the CA proposes commitments. The firm observes the profit level π and accepts or not.

The CA is fully rational and maximizes the intertemporal expected total welfare.

In what follows, we determine the Perfect Bayesian Equilibria (PBE) of each game, so as to determine to what extent the flexible enforcement may lead a forward-looking CA to under-estimate the benefits of litigation. To do so, we first consider the one-period setting, and then go on to consider the dynamic, two-period enforcement game.

4 The litigation-vs-commitment trade-off and the role of legal precedent

4.1 The static choice

We first examine the firm behavior in the one-period setting under "strict" enforcement, i.e. when litigation is imposed. Note that in this case the CA has a passive behavior: it merely forwards the SO to the judge for final decision if the practice is detected as being anticompetitive.

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 $\sigma(-f-c)+(1-\sigma)E(\pi)$, and therefore the probability for type A to adopt the practice is given by $a^{Lit} =$

$F(\sigma(-sf - c + (1-s)E(\pi)) + (1-\sigma)E(\pi))$, where $E(\pi)$ is the expected profit obtained through the adoption of the practice: $E(\pi) = \int_{\underline{\pi}}^{+\infty} \pi g(\pi) d\pi$. By the same token, the probability for type P to adopt the practice is $p^{Lit} = F((\sigma + (1-\sigma)s)E(\pi) - (1-\sigma)(c + (1-s)f))$. Finally, the ex ante expected welfare under "strict" enforcement is given by $W^{Lit}(\sigma, s) = \frac{1}{2}p^{Lit}[\sigma W + (1-\sigma)(sW - T)] + \frac{1}{2}a^{Lit}[-(1-\sigma)W + \sigma(-(1-s)W - T)]$.

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

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. Then, if the CA chooses to impose litigation, the resulting expected welfare will equal $-T + \frac{(1-\sigma)p}{\sigma a + (1-\sigma)p} sW - (1-s)W \frac{\sigma a}{\sigma a + (1-\sigma)p}$. If instead the CA chooses to offer commitments, the expected welfare will be different, because the firm's decision to accept or refuse the commitment proposal leads to imperfect screening of types. To see this, consider first type A: this firm will accept the commitments proposal iff the expected profit, given by $-c + (1-s)\pi - sf$, is lower than 0. There is a probability $G(\widehat{\pi})$ for type A to accept the commitments with $\widehat{\pi} = \frac{sf+c}{1-s}$. . In contrast, type P refuses the commitments offer if $-c + s\pi - (1-s)f > 0$. This is always the case 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. Due to this imperfect screening of types, the resulting expected welfare when the CA offers commitments is equal to $\frac{(1-\sigma)p}{\sigma a + (1-\sigma)p}(sW - T) + \frac{\sigma a(1-G(\widehat{\pi}))}{\sigma a + (1-\sigma)p}(-(1-s)W - T)$. Comparing now both values of expected welfare, it is clear that the CA always proposes commitments. The reason

is straightforward: the commitments 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.

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

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

Lemma 1 actually states that the CA has very strong incentives to offer commitments. As before mentioned, this is due to the screening potential of that procedure, together with the fact that the commitments save on litigation costs. But mostly, this stems from the very timing of decisions under the flexible enforcement: when the CA makes the choice between proposing commitments or going directly to trial, the practice has already been adopted, so the procedural choice has no longer an impact on the adoption of the practice. Instead, imposing litigation under the strict enforcement procedure would deter some type A firms from adopting the practice, because the firm is constrained to pay the fine in case of detection, and the firm makes the adoption choice after the CA decided to apply the strict enforcement. This effect is ignored by the CA when, under flexible enforcement, it makes the choice between trial and commitments, simply because this choice is made after the firms determined whether or not to adopt the conduct.

To sum up so far, in case of flexible enforcement, the CA's equilibrium choice of proceedings is to allow commitments and not impose litigation. 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, so as to determine whether it is actually optimal to always propose commitments. In other words, we will check the conditions under which the CA's equilibrium choice may also be the optimal one.

Under strict enforcement, i.e. when litigation is imposed by the CA, the ex ante expected welfare writes

$$\begin{aligned} W^{Lit}(\sigma, s) &= \frac{1}{2} p^{Lit} \left[\sigma W + (1-\sigma)(sW - T)\right] && (1) \\ &\quad -\frac{1}{2} a^{Lit} \left[(1-\sigma) W + \sigma((1-s)W + T)\right]. && (2) \end{aligned}$$

In contrast, under flexible enforcement, given that the PBE has the CA always propose commitments, the ex ante expected welfare is given by

$$\begin{aligned} W^{Com}(\sigma, s) &= \frac{1}{2} p^{Com} \left[\sigma W + (1-\sigma)(sW - T)\right] \\ &\quad -\frac{1}{2} a^{Com} \left[(1-\sigma) W + \sigma(1 - G(\widehat{\pi}))((1-s)W + T)\right]. && (3) \end{aligned}$$

Note that both expressions involve the probability for type A/P to have adopted the practice under each regime, denoted $a^{Lit/Com}$ and $p^{Lit/Com}$ respectively with:

$a^{Com} = F\left[(1-\sigma)E(\pi) + \sigma \int_{\widehat{\pi}}^{+\infty} ((1-s)\pi - c - sf) g(\pi) d\pi\right]$ and $p^{Com} = p^{Lit}$.

The optimal procedure is determined by comparing the two ex ante expected welfare expressions, hence by the sign of $W^{Lit}(\sigma, s) - W^{Com}(\sigma, s)$. In particular, we can show that

$$W^{Lit}(\sigma, s) - W^{Com}(\sigma, s) < 0 \text{ iff}$$

$$\underbrace{\frac{T + (1-s)W}{W}}_{\text{Litigation cost (denoted } \lambda)} > \underbrace{\frac{1-\sigma}{\sigma}}_{\text{Detection effect}} \times \underbrace{\left[G(\widehat{\pi}) \frac{a^{Com}}{a^{Com} - a^{Lit}} - 1\right]^{-1}}_{\text{Deterrence effect}} \equiv \widehat{\lambda}(\sigma, s). \qquad (4)$$

Condition (4) highlights the three different effects driving the decision on the optimal enforcement regime: a *deterrence effect,* a *litigation cost effect* and a *detection effect.*

First, the flexible enforcement allows the CA to save on litigation costs, since type A may be induced to accept commitments rather than go to trial. These litigation costs include the direct cost of litigation, T, but also the associated welfare loss, given that with probability s the trial may lead to a decision error.

Secondly, a better detection of anticompetitive practices leads the CA to face a higher share of A types. And because of the litigation costs, it is more efficient to offer commitments to these anticompetitive types. In short, a better detection induces the CA to offer commitments. This is the "detection effect", which depends on the detection accuracy σ.

Finally, imposing litigation lowers the incentive for type A to adopt the practice ($a^{Com} > a^{Lit}$), but leaves that of type P unchanged (type P prefers litigation even when commitments are offered: $p^{Com} = p^{Lit} = p$). We call this change in incentives for type A the "deterrence effect" of the strict enforcement. 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, and which cannot be avoided following the initial detection.

The trade-off between these three effects will drive the optimal procedural 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 $\widehat{\lambda}(\sigma, s)$, depends on both accuracy parameters: the one for the quality of detection, σ, and the one for the quality of trial decision, s.

It is straightforward to see that a higher s increases the threshold $\widehat{\lambda}(\sigma, s)$: 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 the errors and increases the benefit of proposing commitments, since they will avoid costly litigation. This increases the detection effect identified previously, and favors the flexible enforcement. But on the other hand, the more accurate detection increases the probability for the bad type to pay the fine if litigation is imposed, while also reducing the probability for the good type to pay the litigation cost. This combination strengthens the deterrence effect of the strict enforcement, and increases its expected benefit.

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) on optimal procedural choice. 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 regime "strong deterrence". Or on the contrary the fine is low, in which case the induced deterrence effect of litigation is quite low and hence the more accurate detection will favor instead the commitments offer (i.e. the flexible enforcement). We call this regime "weak deterrence".

Below we summarize the outcome of the welfare comparison between the strict and flexible enforcement, i.e. the optimal procedural choice (see proof in the Appendix):

Proposition 1 *The optimal procedure choice is the flexible enforcement (i.e. offering commitments) iff the litigation cost is high enough ($\lambda > \widehat{\lambda}(\sigma, s)$). The critical threshold $\widehat{\lambda}(\sigma, s)$ is always increasing with s, but increasing with σ iff the fine f is high enough.*

Proposition 1 clarifies under which condition the CA's equilibrium procedural choice,

i.e. to offer commitments (see Lemma 1), will also be optimal from the welfare point of view: it actually 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) as the optimal procedural choice. But the impact of the detection accuracy on the optimal enforcement option, strict or flexible, is shown to depend on the deterrence achieved when imposing litigation. The monetary penalty paid 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 optimal procedural choice. This result is important because it allows to compare the informational welfare benefit of a more accurate detection under both procedures. We show that a more accurate detection is better valued under the litigation procedure only if the deterrence derived from the monetary penalty is high enough. This is a novel result w.r.t. the existing literature, which actually complements Polo and Rey (2016)[18]. 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 choice

We now examine each type of enforcement when the CA's procedural choice takes into account the future impact of a possible judicial decision at the present period. For this, we consider a two-period setting where the previous game is repeated twice. This two-period framework is intuitive if we consider that a similar practice has a high probability to occur again at the next period, but is much less likely afterwards because of technological progress and innovation. The second period outcome has already been

[18]Their model also points at the trade-off between the deterrence benefit of the trial proceedings and the saving of litigation cost allowed by the commitments procedure, but without considering the CA's detection activity.

fully characterized in the previous section (i.e. the one-period enforcement game). Hence we focus now on the first period enforcement game, in order to identify the conditions under which a fully rational and forward-looking CA may exhibit a possible bias in favor of the commitments proceedings, given the dynamic two-period framework. It has been established (Proposition 1) that there is a strong bias toward commitments at the second period. The pending question is whether this bias is likely to also provide inefficient incentives to adopt commitments at the first period. To answer this, we contrast the procedural choice made by the CA at $t = 1$ with the optimal procedure at the same period.

We begin with the equilibrium. At the first-period, following the detection of the practice, under the flexible enforcement regime, the CA may choose at the current period to either propose commitments or instead directly litigate the case. At the second period, the CA always proposes commitments to the firm (Lemma 1). We identify below the procedure adopted at the first period at the PBE. For this, denote by $\underline{\sigma}$ and $\underline{s}$ the values of parameters σ and s at the first period. Denote $\overline{\sigma}$ and $\overline{s}$ respectively the values of the same parameters at the second period if trial occurs at the first one (where $\overline{\sigma} > \underline{\sigma}$ and $\overline{s} > \underline{s}$). If that is not the case, the values for the second period are still equal to $\underline{\sigma}$ and $\underline{s}$.

The equilibrium procedural choice at $t = 1$ is supported by a welfare comparison at stage 2 of period 1. More precisely, if the CA imposes litigation, the expected welfare is equal to $\frac{p(1-\underline{\sigma})}{p(1-\underline{\sigma})+a^{Lit}\underline{\sigma}}\underline{s}W + \frac{a^{Lit}\underline{\sigma}}{p(1-\underline{\sigma})+a^{Lit}\underline{\sigma}}(-(1-\underline{s})W) - T + W^{Com}(\overline{\sigma},\overline{s})$,

whereas if the CA decides to offer commitments instead, the expected welfare becomes ($p^{Com} = p^{Lit} = p$):

$\frac{(1-\underline{\sigma})p}{(1-\underline{\sigma})p+\underline{\sigma}a^{Lit}}\left[\underline{s}W - T + W^{Com}(\overline{\sigma},\overline{s})\right]$

$+\frac{\underline{\sigma}a^{Lit}}{(1-\underline{\sigma})p+\underline{\sigma}a^{Lit}}\left[(1-G(\widehat{\pi}))(-(1-\underline{s})W - T + W^{Com}(\overline{\sigma},\overline{s})) + G(\widehat{\pi})W^{Com}(\underline{\sigma},\underline{s})\right]$.

The comparison of the two expected welfare expressions shows that litigation is the

equilibrium procedural choice at the first period iff[19] the following condition is satisfied:

$$\underbrace{\frac{(1-\underline{s})W+T}{W}}_{=\lambda} < \frac{W^{Com}(\overline{\sigma},\overline{s})-W^{Com}(\underline{\sigma},\underline{s})}{W} \equiv \widetilde{\lambda}. \tag{5}$$

Explicitly, the static total relative cost of litigation incurred by the CA at the time of the procedural choice, i.e. the LHS side of (5) and which has been previously identified and denoted as λ, must now be compensated by the future relative benefit of legal precedent, the RHS of (5). Clearly, the assessment of the dynamic/future benefit of a first-period trial decision depends on the equilibrium procedural choice at the next period, as shown by the relevant welfare difference, $W^{Com}(\overline{\sigma},\overline{s})-W^{Com}(\underline{\sigma},\underline{s})$. 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 go on now to identify the optimal procedure at the first period, or, equivalently, the opportunity of adopting instead the strict enforcement at $t=1$. Denote $\lambda^{Com/Lit}$ the litigation cost threshold below which imposing litigation is optimal at $t=1$. Then, the CA will inefficiently choose commitments at $t=1$ iff the critical level of litigation cost at the PBE, denoted $\widetilde{\lambda}$, is lower than the optimal litigation cost threshold, $\lambda^{Com/Lit}$.

In order to compare them, two preliminary remarks are helpful.

First, we establish the following:

Lemma 2 *We have always that* $\lambda^{Com/Lit} > \widehat{\lambda}(\underline{\sigma},\underline{s})$.

This means that the optimal litigation cost threshold ($\lambda^{Com/Lit}$) exceeds the critical threshold identified in Proposition 1 if the dynamic effects of litigation are ignored.

[19] The condition does not depend on a. Thus the CA chooses the commitments procedure iff $\lambda > \widetilde{\lambda}$.

The reason is that the litigation procedure yields positive future benefits: the improved future detection and litigation accuracy. These positive benefits logically lead the CA to optimally prefer the strict enforcement for a higher litigation cost.

Secondly, recall that the optimal procedure at $t = 2$ results from the comparison between the litigation cost level, λ, and the critical threshold $\widehat{\lambda}(\sigma, s)$ identified in Proposition 1. As a result, the level of parameters σ and s at $t = 2$ are likely to affect the optimal procedure. But their actual levels depend on the procedure adopted at $t = 1$. Therefore, the choices of optimal procedures at both periods are closely related, since on the one hand, the procedural choice at the present period hinges on the optimal procedure at the following period, but on the other hand the optimal procedure at the second period also depends on the procedural choice at the first period through the levels of parameters σ and s. Because the impact of σ and s on $\widehat{\lambda}(\sigma, s)$ depends on the deterrence regime, we must distinguish between the strong and the weak deterrence respectively. Recall also that with strong deterrence, (a), the higher detection probability makes the litigation procedure relatively more efficient, hence $\widehat{\lambda}(\overline{\sigma}, \overline{s}) > \widehat{\lambda}(\underline{\sigma}, \underline{s})$, whereas with weak deterrence, (b), the improved detection makes the commitments procedure relatively more efficient, and thus we may have $\widehat{\lambda}(\overline{\sigma}, \overline{s}) < \widehat{\lambda}(\underline{\sigma}, \underline{s})$. As a result, depending on the deterrence regime and also on the relative level of litigation cost, there are three situations that need to be considered for the comparison between $\widetilde{\lambda}$ and $\lambda^{Com/Lit}$:

Litigation cost	**(a) strong deterrence**	Optimal procedure at $t = 2$
(ia) high	$\lambda > \widehat{\lambda}(\overline{\sigma}, \overline{s})$	Commitments
(iia) medium	$\widehat{\lambda}(\underline{\sigma}, \underline{s}) < \lambda < \widehat{\lambda}(\overline{\sigma}, \overline{s})$	Com. if $(\sigma, s) = (\underline{\sigma}, \underline{s})$ and Lit. if $(\sigma, s) = (\overline{\sigma}, \overline{s})$
	(b) weak deterrence	
(b) high	$\lambda > \widehat{\lambda}(\underline{\sigma}, \underline{s}) > \widehat{\lambda}(\overline{\sigma}, \overline{s})$	Commitments

Starting with the strong deterrence case, we first consider the high litigation cost subcase (ia): when $\lambda > \widehat{\lambda}(\overline{\sigma}, \overline{s})$, the Commitments procedure is optimal at the second period regardless of the procedure adopted at $t = 1$. In order to determine the optimal procedural choice at $t = 1$, we need to compare the expected welfare levels from imposing litigation:

$$\tfrac{1}{2}p\left[(1-\underline{\sigma})s+\underline{\sigma}\right]W-\tfrac{1}{2}Wa^{Lit}((1-s)\underline{\sigma}+(1-\underline{\sigma}))-\tfrac{1}{2}(p(1-\underline{\sigma})+a^{Lit}\underline{\sigma})T+$$
$$Q^{Lit}\left[W^{Com}(\overline{\sigma},\overline{s})\right]+(1-Q^{Lit})\left[W^{Com}(\underline{\sigma},\underline{s})\right],$$

and proposing commitments:

$$\tfrac{1}{2}p\left[(1-\underline{\sigma})s+\underline{\sigma}\right]W-\tfrac{1}{2}Wa^{Com}((1-s)\underline{\sigma}(1-G(\widehat{\pi}))+(1-\underline{\sigma}))-\tfrac{1}{2}(p(1-\underline{\sigma})+(1-$$
$$G(\widehat{\pi}))a^{Com}\underline{\sigma})T+$$
$$Q^{Com.}\left[W^{Com}(\overline{\sigma},\overline{s})\right]+(1-Q^{Com})\left[W^{Com}(\underline{\sigma},\underline{s})\right],$$

where Q^i denotes the probability of litigation at $t = 1$ under procedure i ($i = Com, Lit$).[20] Then, litigation is the optimal procedural choice at the first period iff:

$$\lambda < \underbrace{\frac{(1-\underline{\sigma})}{\underline{\sigma}}\left[G(\widehat{\pi})\frac{a^{Com}}{(a^{Com}-a^{Lit})}-1\right]^{-1}}_{=\widehat{\lambda}(\underline{\sigma},\underline{s})}+\underbrace{\frac{1}{W}\left[W^{Com}(\overline{\sigma},\overline{s})-W^{Com}(\underline{\sigma},\underline{s})\right]}_{=\widetilde{\lambda}}=\lambda^{Com/Lit}.$$

Clearly, $\lambda^{Com/Lit} > \widetilde{\lambda}$ whenever $\lambda^{Com/Lit} > \widehat{\lambda}(\overline{\sigma}, \overline{s})$.

Note that in this case, the source of inefficiency is purely static, and was already identified before (the term $G(\widehat{\pi})\frac{a^{Com}}{(a^{Com}-a^{Lit})}-1 > 0$). The static bias leads the CA to undervalue the benefit of imposing litigation, and fails to impose it for $\widetilde{\lambda} < \lambda < \lambda^{Com/Lit}$, although it would have been efficient to do so. There is no dynamic inefficiency, because the optimal and the equilibrium procedures at $t = 2$ coincide.

[20] We have that $Q^{Lit} = \frac{1}{2}\underline{\sigma}a^{Lit}+\frac{1}{2}(1-\underline{\sigma})p$, $Q^{Com} = \frac{1}{2}\underline{\sigma}Ga^{Com}+\frac{1}{2}(1-\underline{\sigma})p$ and also $p = p^{Lit} = p^{Com}$.

The second possible subcase with strong deterrence, (iia), is that of an intermediate level of litigation cost: $\widehat{\lambda}(\underline{\sigma},\underline{s}) < \lambda < \widehat{\lambda}(\overline{\sigma},\overline{s})$. Here, the optimal procedure at $t=2$ depends on the quality of the detection signal: if the latter is high following litigation at $t=1$, then the optimal procedure at $t=2$ is litigation, whereas if it remains low due to the absence of litigation at $t=1$, the optimal procedure at $t=2$ is commitments. Hence litigation is optimal at the first period iff:

$$\lambda < \tfrac{1}{W}\left[W^{Lit}(\overline{\sigma},\overline{s}) - W^{Com}(\underline{\sigma},\underline{s})\right] - \tfrac{(a^{Lit}-a^{Com})(1-\underline{\sigma})}{[a^{Lit}-(1-G)a^{Com}]\underline{\sigma}} = \lambda^{Com/Lit}.$$

Therefore $\lambda^{Com/Lit} - \widetilde{\lambda} =$

$$\frac{(1-\underline{\sigma})}{\underline{\sigma}}\left[G(\widehat{\pi})\frac{a^{Com}}{(a^{Com}-a^{Lit})}-1\right]^{-1} + \frac{1}{W}\left[W^{Lit}(\overline{\sigma},\overline{s}) - W^{Com}(\underline{\sigma},\underline{s})\right].$$

But with strong deterrence, we have that $\left[W^{Lit}(\overline{\sigma},\overline{s}) - W^{Com}(\underline{\sigma},\underline{s})\right] > \left[W^{Lit}(\overline{\sigma},\overline{s}) - W^{Com}(\overline{\sigma},\overline{s})\right] > 0$. It follows that with an intermediate level of litigation cost, it holds that $\lambda^{Com/Lit} > \widetilde{\lambda}$. Here, the CA's under-incentives to impose litigation are partly due to the inefficient procedural choice at $t=2$: the CA will propose commitment at $t=2$ although it would have been optimal to impose litigation due to the high quality of the detection signal. With strong deterrence, a better detection makes litigation relatively more efficient, therefore the sub-optimal choice at $t=2$ leads the CA to under-estimate the benefit of litigation at $t=1$. The dynamic benefits of litigation strengthen the CA's under-incentives to impose litigation.

Turning now to the weak deterrence regime (b), note that the same outcome prevails as in subcase (ia), where the inefficiency is only static, since at $t=2$ the equilibrium procedure still coincides with the optimal one. This does not come as a surprise given that with weak deterrence, the improved detection strengthens the optimality of the Commitments procedure, which is also the procedure that the CA adopts in equilibrium.

To sum up, and in line with the interpretation of the procedural choice as an investment in future detection accuracy, we find that the flexible enforcement leads to a miscalculation of this investment cost, which is always over-estimated since the deterrence effect of 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. the strong deterrence regime applies).

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

Proposition 2 *(1) The CA always fails to impose litigation for intermediate levels of litigation cost,* i.e. *for* $\lambda \in \left[\widetilde{\lambda}, \lambda^{Com/Lit}\right]$.

(2) The CA under-estimates the informational value of the litigation procedure iff the monetary penalty upon the trial conviction is deterrent enough, i.e. when the strong deterrence regime applies.

Proposition 2 provides two implications.

First, for intermediate level of litigation costs the litigation procedure should be imposed because the CA fails to do so.

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 gives rise to dynamic inefficiency. More precisely, the fact that the CA will not litigate tomorrow reduces her incentives to impose trial today. To see this, recall that with strong deterrence, the welfare benefit of a better detection accuracy is higher when litigation is imposed rather than if the CA offers 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 under-estimate the benefit to impose litigation today: tomorrow's static inefficiency creates dynamic inefficiency today. 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, allowing for key effects that have not been previously combined in the same framework: the deterrence of the primary behavior by the different instruments of the policy-maker (commitments or prohibitions), the ensuing welfare trade-off, and the dynamic perspective through the focus on legal precedents. 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 the optimal (i.e. when the agency imposes the type of proceedings) and equilibrium (i.e. when the agency chooses between the two proceedings) enforcement options. In a purely static setting we identify a first inefficiency affecting the optimal enforcement choice: the CA underestimates the benefit of litigation and therefore imposes trial in equilibrium less often than it is optimal. In a dynamic setting allowing for the creation of precedent, and thereby increased accuracy of detection and adjudication following an initial trial outcome, we find that the above-mentioned inefficiency makes the CA either under- or over-estimate 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 commitments proceedings.

The dynamic perspective allows us to enrich the usual trade-off behind the optimal procedural choice. Previous analyses focused on the opposition between the commitments proposal on the one hand, as a more efficient procedure which triggers self-selection of practices/firms and saves on procedural and legal costs, and litigation on the other hand, as a more deterring enforcement option. This trade-off is now more complex due to the dynamic impact of trial, which makes room for improving the future detection of the incriminated practice through the creation of precedent. We argue that the deterrence effect associated with the antitrust enforcement is crucial for the role played by the dynamic impact of litigation on this trade-off. In particular, the strong deterrence of anticompetitive practices favors the strict enforcement, and in terms of procedural choice, the dynamic effect makes litigation even more appealing.

Our results suggests that a flexible antitrust enforcement that allows for commitments proceedings has potentially a cumulative and self-reinforcing effect over time, depending on the strength of the deterrence effect associated with trial and detection. The policy implication of our results is that the commitments proceedings is not the optimal procedural choice when the antitrust enforcement achieves substantial deterrence of anticompetitive practices.

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6 Appendix

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

Type P chooses litigation over commitments iff $s\pi - c - (1-s)f > 0$. This is always the case, by assumption, so type P always chooses litigation and refuses commitments.

Type A chooses litigation over commitments iff $(1-s)\pi - c - sf > 0$, i.e. $\pi > \frac{c}{1-s} + \frac{sf}{1-s} = \widehat{\pi}$. Thus type A refuses commitments iff $\pi > \widehat{\pi}$.

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 $\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}(sW - T) + \frac{\sigma(1-G)a}{\sigma a+(1-\sigma)p}(-(1-s)W - T)$, with the expected welfare if the CA imposes litigation, which is $-T + \left(\frac{(1-\sigma)sp}{\sigma a+(1-\sigma)p} - \frac{\sigma a(1-s)}{\sigma a+(1-\sigma)p}\right) W$. Because $a^{Com} = F\left[(1-\sigma)E(\pi) + \sigma \int_{\widehat{\pi}}^{+\infty}((1-s)\pi - c - sf)g(\pi)d\pi\right] > 0$ and $a^{Lit} = F\left[E(\pi) - \sigma(sE(\pi) - c - sf)\right] > 0$, it always holds that $\frac{(1-\sigma)p}{\sigma a+(1-\sigma)p}(sW - T) + \frac{\sigma(1-G)a}{\sigma a+(1-\sigma)p}(-(1-s)W - T) > -T + \left(\frac{(1-\sigma)sp}{\sigma a+(1-\sigma)p} - \frac{\sigma a(1-s)}{\sigma a+(1-\sigma)p}\right) W$.

■

Proof of Proposition 1. We determine here the optimal procedural choice between the strict and the flexible enforcement. For this we need to compare the corresponding ex ante expected welfare levels:

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

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

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

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

The difference between the two writes: $W^{Com}(\sigma,s)-W^{Lit}(\sigma,s)$

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

We consider here only the interesting case where $a^{Lit}-a^{Com}+G(\widehat{\pi})a^{Com}>0$ (otherwise litigation is always optimal):

we have that $W^{Com}(\sigma,s)-W^{Lit}(\sigma,s)>0$ iff: $\frac{T+(1-s)W}{W}=\lambda>$

$\left[\frac{\sigma}{1-\sigma}.\frac{\int_{\underline{\pi}}^{\widehat{\pi}}((1-s)\pi-c-sf)g(\pi)d\pi+G(\widehat{\pi})\int_{\widehat{\pi}}^{+\infty}((1-s)\pi-c-sf)g(\pi)d\pi}{-\int_{\underline{\pi}}^{\widehat{\pi}}((1-s)\pi-c-sf)g(\pi)d\pi}+\frac{G(\widehat{\pi}).E(\pi)}{-\int_{\underline{\pi}}^{\widehat{\pi}}((1-s)\pi-c-sf)g(\pi)d\pi}\right]^{-1}$

$=\left[\frac{\sigma}{1-\sigma}A+B\right]^{-1}\equiv\widehat{\lambda}(s,\sigma)$, with $B>0$.

The sign of A depends in particular of the level of f. We have $\frac{\partial A}{\partial\lambda}<0$. It follows that if f is high enough, then we may have $A<0$. Thus the critical threshold $\widehat{\lambda}(s,\sigma)$ increases with σ iff $A<0$.

In addition, if s increases, $\left[\frac{\sigma}{1-\sigma}A+B\right]^{-1}$ increases, so that $\widehat{\lambda}(s,\sigma)$ increases with s.

Note that the welfare differential $W^{Com}(\sigma,s)-W^{Lit}(\sigma,s)$ is a linear function of the litigation cost, λ.

It follows that if $A<0$, $W^{Com}(\sigma,s)-W^{Lit}(\sigma,s)$ decreases with σ. Instead, if $A>0$, we have that $W^{Com}(\sigma,s)-W^{Lit}(\sigma,s)$ increases with σ for $\lambda>\widehat{\lambda}(s,\sigma)$.

■

Proof of Lemma 2 and Proposition 2. Expected welfare with flexible enforcement at both periods writes:

$\frac{1}{2}p\left[(1-\underline{\sigma})s+\underline{\sigma}\right]W-Wa^{Com}((1-s)\underline{\sigma}(1-G)+(1-\underline{\sigma}))-\frac{1}{2}(p(1-\underline{\sigma})+(1-G)a^{Com}\underline{\sigma})T$

$+\frac{1}{2}(1-(p(1-\underline{\sigma})+(1-G)a^{Com}\underline{\sigma}))W^{Com}(\underline{\sigma},\underline{s})+\frac{1}{2}(p(1-\underline{\sigma})+(1-G)a^{Com.}\underline{\sigma})W^{Com}(\overline{\sigma},\overline{s}).$

with $G=G(\widehat{\pi})$.

Denote Q^i the probability of trial under enforcement $i=Com,Lit$, and α^i the probability that the commitments proposal is the optimal procedure at $t=2$ if procedure i was used at $t=1$.

Then expected welfare with optimal enforcement at $t = 2$ and strict enforcement at $t = 1$ is given by:

$\frac{1}{2}p\left[(1-\underline{\sigma})s+\underline{\sigma}\right]W - \frac{1}{2}Wa^{Lit}((1-s)\underline{\sigma}+(1-\underline{\sigma})) - \frac{1}{2}(p(1-\underline{\sigma})+a^{Lit}\underline{\sigma})T+$

$Q^{Lit}\left[(1-\alpha^{Lit})W^{Lit}(\overline{\sigma},\overline{s})+\alpha^{Lit}W^{Com}(\overline{\sigma},\overline{s})\right]$

$+(1-Q^{Lit})\left[(1-\alpha^{Com})W^{Lit}(\underline{\sigma},\underline{s})+(1-\alpha^{Com})W^{Com}(\underline{\sigma},\underline{s})\right].$

By the same token, expected welfare with optimal enforcement at $t = 2$ and flexible enforcement at $t = 1$ writes:

$\frac{1}{2}p\left[(1-\underline{\sigma})s+\underline{\sigma}\right]W - \frac{1}{2}Wa^{Com\cdot}((1-s)\underline{\sigma}(1-G)+(1-\underline{\sigma})) - \frac{1}{2}(p(1-\underline{\sigma})+(1-G)a^{Com}\underline{\sigma})T+$

$Q^{Com}\left[(1-\alpha^{Lit})W^{Lit}(\overline{\sigma},\overline{s})+\alpha^{Lit}W^{Com}(\overline{\sigma},\overline{s})\right]$

$+(1-Q^{Com})\left[(1-\alpha^{Com})W^{Lit}(\underline{\sigma},\underline{s})+(1-\alpha^{Com})W^{Com}(\underline{\sigma},\underline{s})\right].$

Note that $Q^{Lit} = \frac{1}{2}\underline{\sigma}a^{Lit} + \frac{1}{2}(1-\underline{\sigma})p$, $Q^{Com} = \frac{1}{2}\underline{\sigma}Ga^{Com} + \frac{1}{2}(1-\underline{\sigma})p$, and also $p = p^{Lit} = p^{Com}$.

From Proposition 1, the probability α^i is as follows:

Case a (strong deterrence): $\widehat{\lambda}(\underline{\sigma},\underline{s}) < \widehat{\lambda}(\overline{\sigma},\overline{s})$

(ia) for $\lambda > \widehat{\lambda}(\overline{\sigma},\overline{s})$, then $\alpha^i = 1$;

(iia) for $\widehat{\lambda}(\underline{\sigma},\underline{s}) < \lambda < \widehat{\lambda}(\overline{\sigma},\overline{s})$, then $\alpha^{Lit} = 0$ and $\alpha^{Com} = 1$.

Case b (weak deterrence): $\widehat{\lambda}(\underline{\sigma},\underline{s}) > \widehat{\lambda}(\overline{\sigma},\overline{s})$

for $\lambda > \widehat{\lambda}(\underline{\sigma},\underline{s})$, then $\alpha^i = 1$.

It is optimal to impose strict enforcement at $t = 1$ iff

$\left[(1-\alpha^{Lit})W^{Lit}(\overline{\sigma},\overline{s}) - (1-\alpha^{Com})W^{Lit}(\underline{\sigma},\underline{s}) + \alpha^{Lit}W^{Com}(\overline{\sigma},\overline{s}) - \alpha^{Com}W^{Com}(\underline{\sigma},\underline{s})\right]\times$

$\left[a^{Lit}-(1-G)a^{Com}\right]\underline{\sigma}$

$-(W(1-s)+T)(a^{Lit}-(1-G)a^{Com})\underline{\sigma} - W(a^{Lit}-a^{Com})(1-\underline{\sigma}) > 0$

$\Leftrightarrow \left[(1-\alpha^{Lit})W^{Lit}(\overline{\sigma},\overline{s}) - (1-\alpha^{Com})W^{Lit}(\underline{\sigma},\underline{s}) + \alpha^{Lit}W^{Com}(\overline{\sigma},\overline{s}) - \alpha^{Com}W^{Com}(\underline{\sigma},\underline{s})\right]$

$-(W(1-s)+T) - W\frac{(a^{Lit}-a^{Com})(1-\underline{\sigma})}{[a^{Lit}-(1-G)a^{Com}]\underline{\sigma}} > 0$, which can be rewritten as

$\lambda = \frac{(W(1-s)+T)}{W}$

$< \frac{1}{W}\left[(1-\alpha^{Lit})W^{Lit}(\overline{\sigma},\overline{s}) - (1-\alpha^{Com})W^{Lit}(\underline{\sigma},\underline{s}) + \alpha^{Lit}W^{Com}(\overline{\sigma},\overline{s}) - \alpha^{Com}W^{Com}(\underline{\sigma},\underline{s})\right]$
$+\frac{(a^{Com}-a^{Lit})(1-\underline{\sigma})}{[a^{Lit}-(1-G)a^{Com}]\underline{\sigma}} = \lambda^{Com/Lit}$.

Since $\left[(1-\alpha^{Lit})W^{Lit}(\overline{\sigma},\overline{s}) - (1-\alpha^{Com})W^{Lit}(\underline{\sigma},\underline{s}) + \alpha^{Lit}W^{Com}(\overline{\sigma},\overline{s}) - \alpha^{Com}W^{Com}(\underline{\sigma},\underline{s})\right] > 0$ in all cases, we have that $\lambda^{Com/Lit} > \frac{(a^{Com}-a^{Lit})(1-\underline{\sigma})}{[a^{Lit}-(1-G)a^{Com}]\underline{\sigma}} = \widehat{\lambda}(\underline{\sigma},\underline{s})$. ■