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STRATEGIC LENIENCY: INSIGHTS FROM GAME THEORY AND EMPIRICAL EVIDENCE

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Abstract. Strategic leniency signifies potential exploits of leniency that could generate detrimental effects. Leniency could be exploited in three distinct ways: (1) used to punish cartel deviator; (2) used as a cartel exit strategy; (3) used as a way to report false cartels hoping that rivals will be fined. Strategic leniency has roots in game theory and has been used in theoretical works on leniency. However, it is difficult to verify, whether firms actually conceive leniency strategically. The article addresses the problem by analysis of 42 cartel cases, investigated by the European Commission, throughout the years 2010–2018. We find some support for the strategic leniency, but evidence is more indicative, rather than conclusive. We also find that 2002 leniency reform in the European Union generated no immediate disruptive effect on pre-reform cartels. Besides the article argues for insufficiency of leniency to uncover cartels in a form of concerted practices, and spots a seeming legal gap: there are no legal rules in current Leniency Notice to prevent abuses of leniency. Overall, the success of leniency should not be overstated.
Keywords: cartels, concerted practices, punishment, prisoner's dilemma, strategy.

I. INTRODUCTION

The purpose of the article is to discuss the idea of strategic leniency in the EU competition law and to provide related empirical findings from the EC's case law. According to the EC, leniency is very effective in finding cartels (European Commission, 2020). Currently, there is no comparable alternative to leniency for a discovery of cartels at the EU level, therefore leniency will likely remain the primary legal tool for cartel detection in a foreseeable future; thus, it is important to examine the effectiveness of leniency. In this regard, the article provides the exposition of the idea of strategic leniency that comes from economic and game theory research on leniency. Insights from game theory point to potential exploits of leniency that may be detrimental or even pro-collusive. The analysis is enriched by empirical results from 42 cartel cases, investigated by the EC throughout the years 2010–2018.

The legal mechanism of leniency is rather straightforward: a first undertaking, who reports a cartel to the EC, may get full immunity from cartel fines, while all subsequent applicants may get a reduction of fines up to 50 % (Leniency Notice, 2006). Leniency rules aim to provide incentives for cartel members to report cartels to the EC: in exchange for cooperation, the EC provides immunity or a reduction of fines. In this way, cartels, which would remain undiscovered otherwise, are being disclosed.

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Due to the importance and prevalence of leniency in cartel detection[2], legal and economic research on leniency is ever-growing. Spagnolo and Marvao (2016) provide a detailed summary of this body of research. They identify some problems related to leniency: the idea of too general leniency policy; limited effect of leniency on cartel deterrence; too low level of fines; over excessive use of leniency; poor leniency designs; empirical problem in establishing positive effects of leniency, etc. Miller (2009, p. 751), for instance, even suggests that competition authorities may have incentives to overstate the success of leniency. Thus, the EC's claims of the success of leniency need to be taken with caution. In this line of research, we further investigate the topic and focus on three specific issues of leniency described below.

(1) The issue of leniency and concerted practices. Leniency Notice (2006, item 1 of section I) defines cartels both as cartel agreements and/or concerted practices. These two forms of cartels differ in many important aspects, such as the complexity of cartel arrangement, traceable evidence, intensity of communication, etc.; not to mention, legal differences in proving these infringements. Based on that, *we put forward the idea that the statements on the effectiveness of leniency need to be qualified, depending on the form of a cartel*. In other words, leniency rules might be effective against *cartel agreements*, but at the same time, may not work for *concerted practices* (tacit collusion), which is comparably more difficult to detect and prove from a legal point of view. This remark has implications for theoretical models of leniency that, especially in economic research, tend to abstract from legal differences among distinct types of cartels (Spagnolo, 2000; Motta and Polo, 2003; Harrington, 2008; Chen and Rey, 2013). In particular, modeling parameters like a probability of detection or a probability of proving concerted practices outside the framework of leniency actually might be very low, making these parameters of limited use in formal models of leniency. Thus, theoretical results obtained by these models might be valid for cartel agreements, and not necessarily extend to concerted practices. In section II we elaborate further on why leniency is problematic to apply in cases of concerted practices, and section V empirically reinforces the observation.

(2) The issue of strategic leniency. Strategic leniency could be defined as a set of ways that firms could employ to exploit leniency. In turn, strategic leniency could generate undesirable pro-collusive effects. The idea comes from game theory considerations of leniency rules. Based on examined literature, we could distinguish three different ways of strategic leniency: leniency as a punishment; leniency as a cartel exit strategy; false leniency submission. Section III describes the basic logic behind these three different ways of strategic leniency. Yet, the key problem is to verify, if firms actually employ leniency strategically. Therefore, in section V, we provide empirical findings related to strategic leniency.

(3) The issue of the disruptive effect of leniency. Disruption and deterrence are the two main effects of leniency on cartels. Deterrence refers to *ex ante* prevention of cartel formation, whereas disruption points to *ex post* effect of leniency making already existing cartels less stable. A successful leniency policy must generate both of these effects. However, the problem lies in their empirical

2 During the years 2010–2018, around 90 % of all cartel cases dealt by the EC originated from leniency applications (section V).

verification: even if we can observe frequency (number) and fluctuation (increase and decrease) of leniency applications, the total number of cartels in all markets remains unknown (Harrington, 2008, p. 238). Therefore, a simple increase in the frequency of leniency applications is only an indicative metric for measuring the effectiveness of leniency. Looking historically, the 1993 leniency reform in the U.S. has been widely regarded as a major improvement of leniency rules because the frequency of leniency applications increased significantly. Spagnolo (2008, p. 266) emphasizes that this seeming success of 1993 leniency reform is mainly because of the introduction of "automatic leniency", i.e. the limitation of competition authority's discretion in granting or rejecting full immunity. In the EU similar reform took place in 2002. Thus, assuming that in 2002 leniency rules became very effective, we could assess, whether pre-reform cartels collapsed soon after the reform, i.e. whether 2002 leniency reform generated observable disruptive effect. For that matter, section V sheds light on the disruptive effect of leniency as well as provides general empirical observations related to leniency.

Structure and contributions. The structure of the article follows the issues described above. The article contributes by the exposition and the attempt to empirically verify the idea of strategic leniency. The idea itself is not entirely new. Yet, in the examined literature strategic aspects of leniency tend to be explored on a theoretical level without empirical verification. Also, it appears that leniency has the gap: currently, there are no legal rules to prevent abuses of leniency; this gap could be rectified by amending Leniency Notice (2006). Also, the article contributes by emphasizing the limitations of leniency with regards to concerted practices and providing empirical findings, which might be useful for further research on the topic.

II. LENIENCY: CONCERTED PRACTICES

The main idea of this section is that the effectiveness of leniency may depend on the type of cartel. We further provide reasons, why leniency might not work against concerted practices. Article 101 of TFEU distinguishes cartel agreements from concerted practices. These distinct types of cartels differ, for instance, in terms of complexity, intensity, evidence left, and many other parameters. According to the CJEU, concerted practices are the least intense form of a cartel (Commission of the European Communities v. Anic Partecipazioni SpA, 1991, §131). It is usually proven by indirect evidence, thus firms could find it difficult to adduce a coherent body of evidence for leniency. In general, tacit and indirect nature of concerted practices makes leniency applications more difficult, compared to cases of cartel agreements.

Also, the definition of concerted practices is rather vague (Imperial Chemical Industries Ltd. v. Commission of the European Communities, 1972, §64). One can think of concerted practices as a concept, which defines the scope of the whole Article 101 of TFEU. Therefore, it is a natural reason, why the concept is defined in broad and general terms. Despite that, it causes a problem of the distinction between concerted practices and conscious parallelism, which is especially stark in oligopolies; this legal problem is also referred to as the oligopoly problem (Petit, 2013). In particular, parallel behaviour could result both from concerted practices (illegal) and conscious parallelism (legal). Hence, not only

there is a practical problem to adduce coherent body of evidence of concerted practices for leniency, but also a conceptual problem to distinguish, whether "practices" are concerted.

Finally, not only the *outer boundary* between concerted practices and conscious parallelism is not clear, but also the *inner boundary* between concerted practices and agreement is not in place. Recall that agreements include informal "gentlemen" agreements, thus it is difficult to draw a sharp line between agreements and concerted practices. This difficulty explains why since 1991 the CJEU established the concept of "complex infringement", making, for practical purposes, the distinction between these two distinct types of cartel unnecessary (Rhône-Poulenc SA and others v. Commission of the European Communities, 1991, §127). Nevertheless, our points made in this section holds to the extent that there are cartels that are purely concerted practices.[3]

In conclusion, it seems that leniency faces additional problems in cases of concerted practices. Interestingly, the main conceptual problem, i.e. to provide a clear and sharp definition of concerted practices, could be explained through game theory: competition between firms could be represented in repeated game theory as a prisoner's dilemma, where both cooperation and collusion can appear as a Nash equilibrium without any exchange of information (Carlton et al., 1996, p. 428). We defer a short discussion of elementary game theory and leniency to section IV.

III. STRATEGIC LENIENCY

Strategic leniency signifies potential exploits of leniency that could generate detrimental effects. We, in turn, discuss three distinct ways how leniency could be exploited strategically: (1) used to punish cartel deviator (credible threat); (2) used as a cartel exit strategy (pre-emptive strike); (3) used to report false cartels hoping that rivals get fines (abuse of law).

Credible threat or punishment. Cartels are difficult to sustain. No conspiracy can neglect the problem of enforcement (Stigler, 1964, p. 46). Yet, collusion could be sustained through credible punishments. Thus, if cartel deviations could be punished through leniency, then it may reinforce collusion. The basic idea could be illustrated by hypothetical reasoning: *imagine a duopoly cartel, where firm A deviates from a cartel but did not apply for leniency; then, firm B observes deviation and punishes firm A by applying for leniency; as a result, firm A gets fine, while firm B gets full immunity; understanding this risk, firm A sticks to collusion; therefore, the mere existence of leniency may reinforce collusion.* There are several reasons, why firm A may consider a deviation profitable, but would not like to report itself a cartel to competition authority: (a) leniency only protects from public fines; (b) risk of claims for damages, especially, in the U.S. system with treble damages; (c) harm to firm's reputation and share price; (d) legal restrictions for immunity claims: for example, cartel coercer cannot get full immunity under Leniency Notice (2006, item A(13)); (e) foregone opportunity to renegotiate cartel in the future, etc. It is important to note that by definition, a successful credible punishment (in the context of game theory) needs not to be realized, therefore it is difficult to know if firms actually conceive leniency as a credible punishment. Also note that reasons a – e,

3 In section V we provide some examples of cartel cases that were qualified distinctly as concerted practices.

hold for firm B as well, therefore, at least in some cases, threats of leniency could be non-credible (outside Nash equilibria).

This very idea of leniency as a credible threat has been explored by Spagnolo (2000), who concluded that leniency could prevent cartel deviations even in one-shot Bertrand oligopolies. This result is based on the U.S. leniency rules, where a full immunity is possible only if leniency applicant makes full restitution to injured parties (Corporate Leniency Policy, 1993, item A(5)). By contrast, in the EU restitution of damages is not a necessary precondition to qualify for a full immunity under Leniency Notice (2006). The recovery of damages at the EU level depends on private litigation. For that reason, the Damages Directive has been adopted (Directive 2014/104/EU). Nevertheless, full restitution of cartel profits in the EU is not guaranteed even with the directive in place. Hence, given that a cartel deviator retains at least some of deviation profits, a strategy – to deviate from collusion and simultaneously submit leniency application – could be in equilibrium, i.e. in such scenario leniency cannot be used as a credible threat or credible punishment, because the deviator himself applies for immunity before his rivals observe cheating. This strategy exactly refers to the second possible way to exploit leniency strategically.

Pre-emptive strike. The idea is that firms, which anticipate cartel collapse, may apply for leniency as pre-emptive strike (Blum et. al., 2008). They analysed the idea in the context of the German cement cartel of 2003, where leniency applicant (maverick) had an interest in launching a price war; the cartel was on a verge of collapsed anyways, thus applying for leniency was a smart, profit-maximising move, which prevented potential retaliation through leniency from other cartel members; authors claim that this strategic leniency increases individual market power, which could finally lead to monopoly and therefore is detrimental (Blum et. al., 2008, p. 211). Besides, we can think that leniency is unlikely to produce the disruptive effect (in cases like the abovementioned) because a cartel would have collapsed regardless of leniency due to the existence of a maverick firm. So, instead of giving an additional competitive advantage to a maverick firm and relieving it from fines, cartels could be traced from a price war.[4]

Abuse of law. From the Sokol's (2012) survey emerges the third way of strategic leniency, which, by the majority of surveyed leading antitrust practitioners in the U.S. were described as a reality: firstly, a firm through leniency provide questionable information about alleged cartels in a "grey area" (where infringement itself is doubtful); secondly, rivals are exposed to costly antitrust investigation and are unwilling to litigate therefore accepts reduced fines, i.e. settle (Sokol, 2012, p. 212). In essence, this resembles an abuse of law and causes a risk for false negatives. Perhaps the main "grey area" in EU cartel law is already mentioned difficulty in oligopolies to make a distinction between concerted practices (prohibited) and conscious parallelism (allowed). A closer look at the Leniency Notice (2006) reveals a legal gap: there are no rules or mechanisms to prevent these "cheap" leniency applications. The Leniency Notice (2006) could be improved by establishing new rules that would prevent and punish attempts to abuse leniency; as a result, it would not potentially save the EC's

4 It is hard to know, if this strategic use of leniency is widespread, because actual reasons for leniency applications remains unknown, is not reported in decisions, and essentially remains known only for a decision-makers in a particular firm.

limited resources but prevent false positives as well. Although there is no publicly available data on the rejected leniency applications (on the ground that there has been no infringement), since antitrust practitioners report the pervasiveness of this form of strategic leniency, it should not be ignored.

Overall, the reviewed literature suggests that leniency could be exploited both in passive and active ways. In the passive form, leniency exists merely as a potential, credible threat, which might never be realized, and which allows sustaining collusive profits. Unfortunately, this effect of leniency is unobservable. In the active form, leniency might be used strategically: firstly, as a realized credible punishment, that is as an actual leniency submission, which results in fines; secondly, as a pre-emptive strike, i.e. used by the firm, who desires not only to deviate from a cartel but also to gain an additional competitive advantage by submitting leniency application before its rivals; thirdly, as a tool with the expectation that rivals will get significant fines, suffer from private litigation and reputational damage, especially in cases where at least some evidence is compatible with collusion, even though there is none. The latter might be conceived as a particular case of abuse of law.

IV. LENIENCY: GAME THEORY CONSIDERATIONS

We further review some elementary game theory related to strategic leniency. A game is a model, which consists of players (firms), strategies (collude / deviate), and outcomes (profit). Games could be represented in strategic form (matric) or extended form (decision tree). In a well-known game of prisoner's dilemma (PD), which is often used to analyse market behaviour, there is the unique Nash equilibrium (NE) – not cooperate (deviate). Accordingly, concerning leniency, the central idea is that competition authorities shall create PD, where reporting a cartel becomes a dominant strategy (Leslie, 2006). However, the unique NE in PD appears only in *one-shot* setting (Figure 1), whereas in *repeated* PD, where players interact repeatedly, cooperation (collusion) may emerge in NE. This important result in game theory is called a Folk theorem (Fudenberg and Maskin, 1986).

	Collude		Deviate	
Collude	4	4	0	8
Deviate	8	0	2	2

Figure 1. Prisoner's dilemma: cartel problem.

Note that cartel members cannot form legally enforceable cartel agreements or concerted practices because of legal restrictions (Article 101(2) of TFEU). Therefore, strategy profiles (deviate, deviate) forms the unique NE, meaning that in a one-shot PD collusion is unlikely.

Does one-shot PD adequately depict the problem of leniency? McAdams (2008) argues that over-focus on PD obscures other insights from game theory on law. Leslie himself notes that competition authorities usually have no evidence to prove a lesser crime as in generic PD, therefore the underlying game is rather a coordination game, where firms aim to mimic each other (Leslie, 2006, p. 457, 460). In this line of critique, we further notice that: (1) in case of leniency, unlike in original

PD, actual payoffs are never symmetric, because leniency is of sequential nature: if one firm gets immunity, then others could get only a reduction in fines; this asymmetry in payoffs is what creates a "racing" effect; (2) it is not clear how authorities could in practice "create" PD: if a cartel already formed despite the existence of leniency, then there is a little competition authority can actively do, except for finding infringement on their own[5], which would disqualify firms from immunity under leniency rules in the first place (Leniency Notice, 2006, item II(10)); (3) in reality, firms usually interact repeatedly, therefore a one-shot PD is naturally limited, thus it rather describes an end-game.

Repeated games provide a more realistic game theory approach to leniency. Not only firms usually interact repeatedly, but also in a repeated setting, unlike in a one-shot setting, the idea of punishment becomes relevant. Hence, strategic leniency refers to markets, where firms interact repeatedly. For our purpose, the most important difference between one-shot PD and infinitely or indefinitely repeated PD is that in the repeated setting there is no unique NE. To illustrate the point, let us consider once more the cartel game (Figure 1). Suppose that the same one-shot game is repeated indefinitely or infinitely. Then, based on a Folk theorem, strategy profiles (collude, collude) could be sustained as a Nash equilibrium, provided discount factor is sufficiently high (Fudenberg and Maskin, 1986). We need to make sure that strategy "collude" for both firms A and B are indeed individually rational and that there are no incentives to deviate, which could be expressed in the following inequality (Motta and Pollo, 2003):

$$\frac{CP}{1-\delta} > DP + \frac{\delta \mathrm{NP}}{1-\delta} \rightarrow \delta > \frac{DP-CP}{DP-NP} \quad (1)$$

The inequality above assumes that DP (deviation profits) > CP (collusive profits) > NP (one-shot Nash equilibrium profits). The left-hand presents an infinite stream of collusive profits, provided that both firms A and B stick to collusion without any deviations, i.e. a stream of profits under perfectly stable collusion. By contrast, the right-hand shows overall profits, if a player decides to deviate instead. Namely, the deviator would get DP once and, starting with the next round, infinite stream of NP, which is discounted by because it takes exactly one round for the other firm to observe deviation. Such a permanent return to the initial one-shot Nash equilibrium is a so-called "grim-trigger" strategy, which means that a single deviation triggers infinite punishment. The punishment itself should be in line with a Nash equilibrium to be credible. Notably, a stronger punishment, than the reversal to the one-shot Nash equilibrium strategy, is unlikely not only because a model would have to assume irrational behaviour, but also because that the Article 102 of TFEU prevents pricing below costs, which is considered as an abuse of dominant position.

By inserting payoffs of the cartel game into (1) inequality, we obtain that strategies (collude, collude) form a subgame perfect Nash equilibrium, provided that agents are sufficiently patient, which means that $\delta > 2/3$ (see below). Therefore, collusion could be self-sustained in a repeated prisoners' dilemma with two firms.

5 As examined case law in section V shows, cartel detection outside leniency is almost nonexistent.

$$\delta > \frac{8-4}{8-2} \rightarrow \delta > 2/3 \quad (2)$$

Implications for strategic leniency. Firstly, Leslie's (2006, p. 465) proposition that competition authorities should create PD, is not the end of the story, because collusion could be sustained as the Nash equilibrium in infinitely or indefinitely repeated games, including PD. Secondly, given full-immunity regime under leniency, the right-hand of inequality (1) remains unchanged, thus we can predict that a majority of cartel deviators (mavericks) will be whistle-blowers as in Blum et al. (2008). Nevertheless, leniency grants full-immunity only from public fines, meaning that exposed cartel may lead to private claims for damages, reputational harm, and similar negative effects on profits, which could reduce deviation profits (DP) in the first place, making use of leniency less likely even for a deviator. Thirdly, given that a cartel deviator does not apply for leniency, then it could be incorporated into a credible punishment strategy. In particular, rivals could not only play competitive one-shot NE strategies, which would give NP for a deviator but further impose harm that comes from antitrust fines, private damage claims, etc. In this sense, leniency functions as a credible threat or punishment: leniency allows punishing the deviator even more severely, than a simple reversal to one-shot NE strategy.[6] Finally, since public fines and other negative effects from leniency application appears in the right-hand of inequality (1), we could conceive leniency as a special type of punishment, which *ex ante* may be exploited strategically and, consequently, reinforce collusion. This applies especially to duopolies and situations, where one or more firms are ineligible for leniency.

V. EMPIRICAL FINDINGS

In this section, we provide some findings based on the examined EU cartels with regards to previously raised issues of strategic leniency and concerted practices. During the period 2010–2018 there were in total 42 cartels investigated by the EC (Table 1 in the Appendix).

a) General observations

Leniency is the key source for cartel investigations. We found that 37/42 cartels originated from leniency (Table 1 in the Appendix). It shows the importance of leniency in cartel detection, but it does not show the effectiveness of leniency rules as such, because a total number of cartels (revealed and unrevealed), remains unknown (Harrington, 2008, p. 238). Also, the question arises, whether the EC, is sufficiently capable of finding cartels outside the framework of leniency, or perhaps, leniency generates enough workflow, which exhausts the EC's resources for stand-alone investigations.

The ratio of prohibition decisions tends to decrease. We found that the EC adopted prohibition decisions in 33/42 of cases (Table 1 in the Appendix). Figure 2 below shows that prohibition decisions

6 In addition, note that in a case of duopoly, leniency could become a targeted punishment. In principle, every restriction on eligibility of leniency brings leniency closer to a targeted punishment. Therefore, we could argue that coercers and instigators of cartels should not be barred from a full-immunity under leniency rules in order to neutralize pro-collusive effects, which comes from the existence of targeted punishments.

tend to slightly decrease in relation to other types of decisions. One possible explanation would be that after the development of a sufficient level of legal practice and legal certainty, firms are less willing to litigate. This tendency is in line with the fact that the majority of cartel investigations come from leniency, meaning that there usually exists strong internal incriminating evidence.

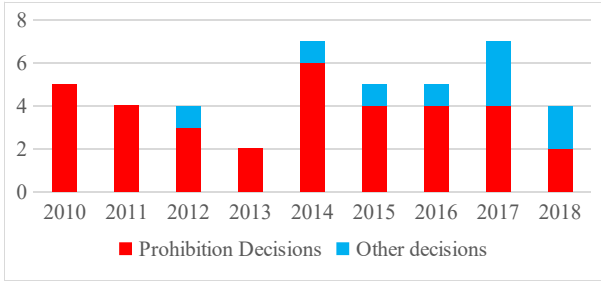

Figure 2. Prohibition decisions.

We observe very limited disruptive effect, at least immediate, of 2002 leniency reform on pre-reform cartels. Assuming that "automatic leniency" is a major improvement in leniency rules (Spagnolo, 2008, p. 266, 290), which were introduced in the EU in 2002, we were able to test, whether the reform generated immediate disruptive effect on cartels that have formed before 2002 (pre-reform cartels). Based on strategic considerations, *pre-reform* and *post-reform* cartels are in a different position. Namely, rational firms that have formed cartels after the reform at a stage of cartel formation had to take into consideration improved or "effective" leniency rules, which posed a substantially higher risk of being caught, in comparison with those cartels that formed before the reform with "ineffective" leniency rules or no leniency rules at all.[7] This strategic consideration is also reflected in formal models, such as in Motta and Polo (2003), where they incorporate leniency into deviation strategies. We found 15/42 relevant cases, where cartels formed before the reform. It appears that only in the DRAMS case leniency application has been submitted within 1 year after the entry into force of 2002 leniency rules (12th of February 2002). From this, we conclude that the 2002 leniency reform had very limited, at least immediate, disruptive effect on pre-reform cartels. This observation suggests that leniency is likely not that strong or even a primary precursor of why cartels collapse.

b) Observations regarding concerted practices

We looked for cases, where (1) leniency was the original source of cartel investigation (37/42 cartels), and (2) infringements were qualified distinctly as concerted practices. Not a single case matched these two requirements. This seems to reinforce our previous proposition that leniency is not adequate for concerted practices. Almost all infringements have been qualified as complex infringements (Table 1 in the Appendix).

7 Especially, if we take into consideration the fact that stand-alone cartel detection, i.e. outside the framework of leniency are rare (see the previous trend).

We argue that it is equally important to catch infringements that are distinctly concerted practices because harm to competition could be the same or comparable to harm from complex infringements or cartel agreements. Also, cases, which are distinctly concerted practices, are not just a theoretical possibility, but occur in practice: for instance, in cases of ICI v. Commission (1972), Suiker Unie and Others v. Commission (1975), where the concept of concerted practices has been established; in cases of T-Mobile and Others (2009) and Dole Food v. Commission (2015), where exchanges of information were found as distinct examples of concerted practices; or more recently, in case of Eturas and Others (2016), where the CJEU clarified that a sending of information (about a planned discount cap) by electronic platform administrator may amount to concerted practices.

Furthermore, it seems that the development of the concept of concerted practices has been, at least to some extent, stalled by the emergence of the concept of complex infringement. Currently, we have a situation, where those early judgments of concerted practices still play a major role in judicial reasoning about concerted practices, even though the competitive environment significantly changed in past decades. If we consider a previously noted trend that the ratio of prohibition decisions, where the EC can develop concepts, tend to decrease, we can further raise the question not only, if leniency is effective for concerted practices, but also, whether the concept of concerted practices in a future could deal with more unconventional cartels that employ artificial intelligence, such as algorithmic pricing. It is hard to expect effective enforcement for more sophisticated and less intense forms of collusion (especially in the absence of direct communication or other contacts), without further developments of leniency and concerted practices.

c) Observations regarding strategic leniency

By checking, whether cartel collapses were shortly followed by leniency applications, we could discern whether firms potentially used leniency strategically as a cartel exit strategy (pre-emptive strike). By "shortly" we assumed 6 months.[8] Due to imperfections in data, we further assumed:

(1) That the EC's reaction time to make down raids or requests for information upon receipt of initial leniency application is on average 3 months. There is no specified term for the EC to act on initial receipt of a leniency application, but 3 months average term is mentioned by the EC's representatives (Parliamentary questions E-0890/09, E-0891/09, E-0892/09, 2009). We also deduce same 3 months term from our data, where the EC provide both a date on initial leniency application and date on its down raids or requests for information (Table 3 in the Appendix);

(2) That the EC properly determine actual cartel duration. In practice, a cartel duration may be slightly different from what the EC was able to prove. This is because in some cases the EC may have had a lack of sufficient evidence to prove a longer infringement. Also, even if firms submit leniency applications, they might have incentives to misrepresent the duration of cartels, because they

8 Note, however, that depending on a market, its transparency, firms' ability to detect deviations, frequency of price changes, and other factors, a term for using leniency as a credible punishment or as an exit strategy may vary. In any case, our data allows examining the same question with shorter or longer periods as well.

might be not the first to report cartel and therefore not be eligible for full immunity, or they might have had simply destroyed evidence in the past, etc. Therefore, the real duration of each cartel might be longer than established in the EC's decisions. In the absence of alternatives, it was natural to adopt the dates provided in the EC's decisions.

We find that in 20/37 of cases cartel collapses were shortly followed by leniency submissions, which is in line with the idea of strategic leniency as a pre-emptive strike (Table 4 in the Appendix). However, the remaining 17/37 of cases did not follow the pattern, so we cannot provide very strong conclusions for strategic leniency. In addition, these 17/37 cases also could be interpreted against the effectiveness of leniency: even though cartels collapse, firms are still hesitant to rush to submit leniency applications sometimes for years. This behaviour again could be partially explained by limitations of leniency and usual arguments that firms fear private claims for damages, price wars, reputational harm, foreclosed opportunity to renegotiate cartels, etc., which sometimes might outweight the benefits of leniency, whereas an impetus for eventual leniency applications might be a belief that rivals will soon do so.

Finally, our cursory search in Lithuanian case law adds a further glimpse of evidence in support of Sokol's (2012, p. 212) survey, where the U.S. leading antitrust practitioners noted a reality of strategic leniency. In the Lithuanian Internal Combustion Engine (2017) duopoly case, one defendant put forward arguments that the other defendant intentionally submitted leniency application to completely eliminate competition from its only rival in the market. However, the Supreme Administrative Court of the Republic of Lithuania rejected these arguments on the ground that law did not require checking true intentions behind leniency submissions. This shows that the concept of strategic leniency and its various modes are not yet fully acknowledged by legal authorities and fall outside current legal assessment. However, we think that at least in the most severe attempts to abuse leniency, i.e. with the aim to harm rivals and gain competitive advantage, it should be prohibited and fall within a domain of legal assessment. For that purpose, the current legal gap in the EU competition law should be filled by establishing legal norms that would prevent abuse of leniency.

VI. CONCLUSIONS

Strategic leniency is the idea that comes from game-theoretic considerations of leniency. It gained some attention in theoretical research by legal and economic scholars, but for the most part, the idea is overlooked by competition authorities and courts. We can think of three distinct aspects of strategic leniency.

(1) Leniency implies that firms, who want to deviate from a cartel arrangement but does not want to be exposed to private litigation, reputational harm, etc. could be threatened by rival cartel members, who can punish such deviations by applying for leniency. This possibility may *ex ante* reinforce collusion and prevent deviations in the first place. Since credible threats or punishments by definition need not be realised to be effective, this way of strategic leniency remains

unobservable. Therefore, it is hard to know, if firms actually conceive leniency this way, or it is merely a theoretical construct.

(2) On the other hand, if a cartel is on a verge of collapse and cartel deviator finds it profitable to deviate regardless of private litigation, reputational harm, etc., then a strategy "deviation + leniency application" could be a dominant strategy, which could work as a pre-emptive strike, i.e. could prevent potential punishment through leniency by rival firms. In such cases, where cartels are destined to collapse due to maverick firm, leniency may give an extra competitive advantage to a deviator, which in a long term may help the maverick firm to create or strengthen its dominant position or even eliminate competition. We find some support for the "deviation + leniency application" strategy in the EC case law, but strong conclusions would be unwarranted.

(3) Finally, when the line between legal and illegal behaviour is thin (e.g. in so-called oligopoly problem, where it is difficult to distinguish between concerted practices and conscious parallelism), firms may submit false leniency applications to gain competitive advantage by getting full immunity under leniency and exposing rivals to fines. This may lead to false positives and inefficient use of limited resources of the EC. Currently, the EU leniency rules have no legal norms to prevent such abuses of law. Therefore, one possible solution would be to introduce fines for procedural attempts to abuse leniency.

Through the analysis of 2010–2018 EC's cartel cases, we found that the 2002 EU leniency reform had no disruptive effect, at least immediate, on pre-reform cartels. This finding supports the scholarship position, which argues that the EC tends to overemphasize the effectiveness of leniency. Besides, both theoretical considerations and empirical evidence suggest that leniency is unlikely to reveal concerted practices. As a rule, the EC qualifies cartels as complex infringements, but this practice has negative implications for the development of the concept of concerted practices, which is arguably critical in addressing emerging problems in competition law caused by artificial intelligence and algorithmic pricing.

Despite the critique, leniency remains (and likely will be) the single most important source for cartel detection. Examined cases indeed show that the EC rarely find infringements outside the framework of leniency, even cartels last for five or even more years. Therefore, to make leniency more effective, strategic considerations should be taken into account in future developments of leniency and concerted practices, which in turn may help to address emerging problems in digital markets or due to artificial intelligence. Game theory as methodology could be fruitfully employed in researching cartel-related problems in competition law, which the author will further explore in his doctoral thesis.

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APPENDIX

Table 1. Cartels investigated by the EC during the years 2010 – 2018.

No	Year	Title	Leniency was a source for investigation	Prohibition decision	Infringement
1	2018	Capacitators	+ (Sanyo)	-	Complex
2	2018	Spark Plugs	+ (Denso)	+	Complex
3	2018	Braking Systems	+ (TRW & Continental)	+	Complex
4	2018	Maritime Car Carriers	+ (MOL)	-	Complex
5	2017	Occupant Safety Systems	+ (Tokai Rika & Takata)	+	Complex
6	2017	Lighting Systems	+ (Valeo)	-	Complex
7	2017	Envelopes	-	+	Complex
8	2017	Raw Tobacco (ES)	-	+	Complex
9	2017	Airfreight	+ (Lufthansa)	-	Unspecified
10	2017	Thermal systems	+ (Panasonic & Denso)	-	Complex
11	2017	Car battery recycling	+ (JCI)	+	Complex
12	2016	Rechargeable batteries	+ (Samsung)	+	Complex
13	2016	Euro Interest Rate Derivatives	+ (Barclays)	+	Complex
14	2016	Steel abrasives	+ (Ervin)	+	Complex
15	2016	Mushrooms	+ (Lutèce)	+	Complex
16	2016	Alternators and Starters	+ (Denso)	-	Complex
17	2015	Optical Disc Drives	+ (Philips & Lite-On)	-	Complex
18	2015	Blocktrains	+ (K+N)	+	Complex
19	2015	Retail Food Packaging	+ (Linpac)	+	Complex
20	2015	Parking Heaters	+ (Webasto)	+	Complex
21	2015	Yen Interest Rate Derivatives (YIRD)	+ (UBS)	+	Complex
22	2014	Swiss Franc interest rate derivatives	+ (RBS)	+	Complex
23	2014	Smart card chips	+ (Renesas)	+	Complex
24	2014	Power cables	+ (ABB)	+	Complex
25	2014	Automotive bearings	-	+	Complex
26	2014	Power exchanges	-	-	Complex
27	2014	Polyurethane Foam	+ (Vita)	+	Complex
28	2013	Shrimps	+ (Klaas Puul)	+	Complex
29	2013	Automotive Wire Harnesses	+ (Sumitomo)	+	Complex
30	2012	TV and computer monitor tubes	+ (Chunghwa)	+	Complex
31	2012	Water management products	+ (Pneumatex)	+	Complex
32	2012	Mountings for windows and window-doors	+ (Roto Frank)	-	Complex
33	2012	Freight Forwarding	+ (Deutsche Post)	+	Complex
34	2011	Refrigeration compressors	+ (Tecumseh)	+	Complex
35	2011	CRT glass bulbs	+ (SCP)	+	Complex
36	2011	Exotic fruit	+ (Chiquita)	+	Complex
37	2011	Consumer detergents	+ (Henkel)	+	Complex
38	2010	LCD	+ (Samsung)	+	Complex
39	2010	Animal Feed Phosphates	+ (Kemira)	+	Complex
40	2010	Pre-stressing steel	-	+	Complex
41	2010	Bathroom fittings & fixtures	+ (Masco)	+	Complex
42	2010	DRAMS	+ (Micron)	+	Complex

Source: the EC's cartel database at https://ec.europa.eu/competition/elojade/isef/index.cfm
Note: Sometimes the EC's delay to publish prohibition decisions, thus the information in the table reflect actual data that were available on 1 January 2020.

Table 2. Cartels that emerged before the 2002 leniency reform and lasted afterward.

No	Case	Whistleblower	Date of leniency submission	Cartel duration
1	Capacitators	Sanyo	04/10/2013	Overall: 26/06/1998 – 23/04/2012 Sanyo: 19/09/2001 – 19/04/2011
2	Spark Plugs	Denso	20/04/2011	Overall: 19/01/2000 – 28/07/2011 Denso: 16/02/2000 – 08/02/2010
3	Airfreight	Lufthansa	07/12/2005 (EC opened the case)	Overall: 07/12/1999 – 14/02/2006 Lufthansa: 14/12/1999 – 07/12/2005
4	Retail Food Packaging	Linpac	04/06/2009 (EC made inspections)	Overall: 02/03/2000 – 13/02/2008 Linpac: 02/03/2000 – 13/02/2008
5	Parking Heaters	Webasto	15/11/2012	Overall: 13/09/2001 – 15/09/2011 Webasto: 13/09/2001 – 15/09/2011
6	Power cables	ABB	17/10/2008	Overall: 18/02/1999 – 28/01/2009 ABB: 01/04/2000 – 17/10/2008
7	Shrimps	Klaas Puul	13/01/2009	Overall: 21/06/2000 – 13/01/2009 Klaas Puul: 21/06/2000 – 13/01/2009
8	Automotive Wire Harnesses	Sumitomo	23/11/2009	Overall: 06/03/2000 – 22/12/2009 Sumitomo: 06/03/2000 – 20/10/2009
9	TV and computer monitor tubes	Chunghwa	09/03/2007	Overall: 24/10/1996 – 15/11/2006 Chunghwa: 24/10/1996 – 14/03/2006
10	Mountings for windows and window/doors	Roto Frank	04/05/2007	Overall: 16/11/1999 – 03/07/2007 Roto Frank: 16/11/1999 – 04/05/2007
11	CRT glass bulbs	SCP	2008	Overall: 23/02/1999 – 27/12/2004
12	LCD	Samsung	23/11/2006 (EC granted conditional immunity)	Overall: 05/10/2001 – 01/02/2006 Samsung: 05/10/2001 – 01/02/2006
13	Animal Feed Phosphates	Kemira	28/11/2003	Overall: 19/03/1969 – 10/02/2004 Kemira: 19/03/1969 – 28/11/2003
14	Bathroom fittings & fixtures	Masco	15/07/2004	Overall: 16/10/1992 – 09/11/2004 Masco: 16/10/1992 – 15/07/2004
15	DRAMS	Micron	29/08/2002	Overall: 01/07/1998 – 15/06/2002 Micron: 01/07/1998 – 15/06/2002

Source: the EC's official cartel database at https://ec.europa.eu/competition/elojade/isef/index.cfm

Table 3. The delay between leniency submissions and the EC's inspections.

No	Case	Date of leniency submission	Date of the EC's inspections	Delay (months)
1	Automotive Wire Harnesses	23/11/2009	01/02/2010	3
2	Shrimps	13/01/2009	24/03/2009	2
3	Polyurethane Foam	30/04/2010	27/07/2010	3
4	Power cables	17/10/2008	23/01/2009	3
5	Smart card chips	22/04/2008	23/09/2008	5
6	Euro Interest Rate Derivatives	14/06/2011	18/10/2011	4
7	Lightning systems	01/01/2012	01/07/2012	6
8	Car battery recycling	22/06/2012	22/09/2012	3
9	Steel abrasives	13/04/2010	15/06/2010	2
10	Water management products	21/10/2008	01/12/2008	2
11	Animal phosphates	28/11/2003	10/02/2004	3
12	Pre-stressing steel	18/06/2002	19/09/2002	3
13	Bathroom fittings & fixtures	15/07/2004	01/11/2004	4
			Average:	**3**

Source: the EC's official cartel database at https://ec.europa.eu/competition/elojade/isef/index.cfm

Table 4. Evidence on whether a cartel collapse was shortly followed by a leniency application.

No	Case	Whistle-blower	Cartel duration	Whistle-blower's participation in a cartel	Leniency date	Subtract 3 months	Delay (Months)
1	Airfreight	Lufthansa	07/12/1999 – 14/02/2006	14/12/1999 – **07/12/2005**	07/12/2005	-	0
2	Car battery recycling	JCI	23/09/2009 – 26/09/2012	23/09/2009 – **22/06/2012**	22/06/2012	-	0
3	Steel abrasives	Ervin	03/10/2003 – 15/06/2010	03/10/2003 – **30/03/2010**	13/05/2010 (inspections)	3 months	0
4	Mushrooms	Lutèce	01/09/2010 – 28/02/2012	01/09/2010 – **22/12/2011**	22/12/2011	-	0
5	Power cables	ABB	18/02/1999 – 28/01/2009	01/04/2000 – **17/10/2008**	17/10/2008	-	0
6	Polyurethane Foam	Vita	26/10/2005 – 27/07/2010	26/10/2005 – **30/04/2010**	30/04/2010	-	0
7	Shrimps	Klaas Puul	21/06/2000 – 13/01/2009	21/06/2000 – **13/01/2009**	13/01/2009	-	0
8	Mountings for windows and window-doors	Roto Frank	6/11/1999 – 03/07/2007	16/11/1999 – **04/05/2007**	04/05/2007	-	0
9	Exotic fruit	Chiquita	28/07/2004 – 08/04/2005	28/07/2004 – **08/04/2005**	08/04/2005	-	0
10	Animal Feed Phosphates	Kemira	19/03/1969 – 10/02/2004	19/03/1969 – **28/11/2003**	28/11/2003	-	0
11	Bathroom fittings & fixtures	Masco	16/10/1992 – 09/11/2004	16/10/1992 – **15/07/2004**	15/07/2004	-	0
12	DRAMS	Micron	01/07/1998 – 15/06/2002	01/07/1998 – **15/06/2002**	29/08/2002	-	0
13	Automotive Wire Harnesses	Sumitomo	06/03/2000 – 22/12/2009	06/03/2000 – **20/10/2009**	23/11/2009	-	1
14	Freight Forwarding	Deutsche Post	01/10/2002 – 21/05/2007	01/10/2002 – **21/05/2007**	24/09/2007 (cond. immunity)	3 months	1
15	Braking Systems	TRW & Continental	13/02/2007 – 07/07/2011	TRW: 13/02/2007 – **18/03/2011** Continental: 13/02/2007 – **07/07/2011**	13/07/2011	-	4
16	Maritime Car Carriers	MOL	18/10/2006 – 06/09/2012	18/10/2006 – **24/05/2012**	01/09/2012	-	4
17	Optical Disc Drives	Philips & Lite-On	13/06/2004 – 25/11/2008	23/08/2004 – **25/11/2008**	29/06/2009 (req. information)	3 months	4
18	Water management products	Pneumatex	21/06/2006 – 15/05/2008	21/06/2006 – **15/05/2008**	21/10/2008	-	5
19	Yen Interest Rate Derivatives	UBS	19/01/2007 – 22/06/2010	19/01/2007 – **03/06/2010**	17/12/2010	-	6
20	LCD	Samsung	05/10/2001 – 01/02/2006	05/10/2001 – **01/02/2006**	23/11/2006 (cond. immunity)	3 months	6
21	Blocktrains	K+N	02/07/2004 – 30/06/2012	02/07/2004 – **30/06/2012**	23/03/2013	–	9
22	Occupant Safety Systems	Tokai Rika & Takata	06/07/2004 –26/07/2010	Tokai Rika: 06/07/2004 – **25/03/2010** Takata: 06/07/2004 – 22/05/2010	07/06/2011 (inspections)	3 months	10
23	TV and computer monitor tubes	Chunghwa	24/10/1996 – 15/11/2006	24/10/1996 – **14/03/2006**	09/03/2007	–	12
24	Retail Food Packaging	Linpac	02/03/2000 – 13/02/2008	02/03/2000 – **13/02/2008**	04/06/2009 (inspections)	3 months	13
25	Refrigeration compressors	Tecumseh	13/04/2004 – 09/10/2007	13/04/2004 – **09/10/2007**	11/02/2009 (cond. Immunity)	3 months	13
26	Spark Plugs	Denso	19/01/2000 – 28/07/2011	16/02/2000 – **08/02/2010**	20/04/2011	–	14
27	Alternators and Starters	Denso	14/09/2004 – 23/02/2010	14/09/2004 – **23/02/2010**	22/07/2011 (inspections)	3 months	14
28	Parking Heaters	Webasto	13/09/2001 – 15/09/2011	13/09/2001 – **15/09/2011**	15/11/2012	–	14
29	Thermal systems	Panasonic & Denso	29/11/2004 – 02/12/2009	Panasonic: 14/05/2009 – **21/10/2009** Denso: 11/11/2004 – 02/12/2009	22/07/2011 (inspections)	3 months	16
30	Swiss Franc interest rate derivatives	RBS	07/05/2007 / 07/07/2009	07/05/2007 – **07/07/2009**	09/08/2011	-	25
31	Capacitators	Sanyo	26/06/1998 – 23/04/2012	19/09/2001 – **19/04/2011**	04/10/2013	-	30
32	Smart card chips	Renesas	23/09/2003 – 08/09/2005	23/09/2003 – **08/09/2005**	22/04/2008	-	31
33	CRT glass bulbs	SCP	23/02/1999 – 27/12/2004	23/02/1999 – **27/12/2004**	2008	3 months	34
34	Consumer detergents	Henkel	07/01/2002 – 08/03/2005	07/01/2002 – **08/03/2005**	12/06/2008 (cond. Immunity)	3 months	36
35	Euro Interest Rate Derivatives	Barclays	29/09/2005 – 30/05/2008	29/09/2005 – **30/05/2008**	14/06/2011	-	37
36	Rechargeable batteries	Samsung	01/04/2004 – 10/11/2007	01/04/2004 – **01/10/2007**	02/05/2011	-	41
37	Lighting Systems	Valeo	07/07/2004 – 25/10/2007	07/07/2004 – **25/10/2007**	01/01/2012	-	51

Source: the EC's cartel database at https://ec.europa.eu/competition/elojade/isef/index.cfm