Stockholm Institute of Transition Economics

WORKING PAPER

October 2014

No. 28

What Do We Know about the Effectiveness of Leniency Policies? A Survey of the Empirical and Experimental Evidence

Catarina Marvão or Giancarlo Spagnolo

**STOCKHOLM INSTITUTE OF
TRANSITION ECONOMICS**

What Do We Know about the Effectiveness of Leniency Policies? A Survey of the Empirical and Experimental Evidence

Catarina Marvão and Giancarlo Spagnolo[1]

I Introduction

Over the last decade a large body of economic research has emerged that has sought to empirically test the effectiveness of leniency policies as tools to enhance the detection, prosecution and deterrence of cartel conduct. This research has considerable potential value in assisting competition authorities design optimal policies by having a better understanding of the impact that such policies, their specific features and manner of administration, have on the behaviour of cartel participants. Some researchers have taken the approach of testing empirically the effects of actual policies – predominantly those administered by the United States Department of Justice (USDOJ) and the European Commission (EC) – while others have tested different hypothetical policies in the lab. This section reviews the key studies which have been undertaken to date, it highlights the main findings and compares their results. After appreciating the main contributions and limitations of these studies, it concludes with a general assessment and an agenda for future research,

There is evidence to suggest that, among a range of competition policy features, effective anti-cartel enforcement is by far the most important determinant of positive productivity growth.[2] For competition authorities across the world, leniency policies have become the main instrument of competition law enforcement against 'hard-core' cartels. Optimising the design and administration of leniency policies is therefore a key objective for competition authorities and society at large.

Theoretical research has highlighted the strong potential for well-designed and well-managed leniency policies to contribute to social welfare[3]. However, it has also highlighted the serious risk that poorly implemented leniency policies may have the very opposite effect. As with any form of public law enforcement, competition law enforcement against cartels increases social welfare if the gains that it generates, by reducing the number of cartels in society, are larger than the deadweight losses that it generates in the form of wasteful administration, prosecution and litigation activities.[4]

[2] See P Buccirossi and others, 'Competition Policy and Productivity Growth: An Empirical Assessment' (2013) 95 *Review of Economics and Statistics* 1324.
[3] For a survey, see G Spagnolo, 'Leniency and Whistleblowers in Antitrust' in P Buccirossi (ed), *Handbook of Antitrust Economics* (Cambridge, MIT Press, 2008).
[4] These costs, including those of enforcement agencies, lawyers and consultants, are not linked to any productive activity, and are therefore to be regarded as a net deadweight loss for society. See, eg, AM

An overly generous leniency policy offering fine reductions to several reporting firms may make a competition authority appear very successful in terms of the number of convicted firms, while reducing social welfare by decreasing cartel deterrence and increasing the amount of prosecution costs (because there are more prosecuted cartels).

Law enforcement agencies, including competition authorities, publish the number of successful cartel convictions in their annual reports and these conviction rates represent an obvious performance measure, since deterrence effects are very difficult to observe. As a result, authorities have a natural incentive to use a leniency policy (and plea bargaining) somewhat generously so as to win more cases.[5] If sanctions are robust, as in the United States (US), this may increase the expectation that sanctions will be imposed and thus ultimately increase deterrence. If sanctions are not robust, however, as in most other jurisdictions, this may come at the social cost of reduced cartel deterrence.[6]

An empirical evaluation of implemented leniency policies is crucial in understanding whether they are being administered in a way that is likely to increase social welfare — that is, by reducing cartel formation — or in a way that is likely to decrease social welfare, notwithstanding an increase in the number of cases successfully closed. Evaluating the deterrence effects of leniency policies is difficult, however, as cartels are not readily observable in society unless they are convicted. An increase in the number of convicted cartels following the introduction of a leniency policy cannot necessarily be interpreted as an improvement in antitrust enforcement, as it may simply be due to an increase in the overall number of cartels formed. Simplistic assessments based on changes in the number of discovered and convicted cartels, as present in the motivation of some early theoretical studies of leniency policies, are therefore incorrect and possibly misleading. Substantially more advanced methods need to be employed to correctly infer whether an increase or decrease in the number of convicted cartels is due to better enforcement or due to an increase in the number of cartels present in society.

It is important to know which features of a leniency policy and of the overall law enforcement system are effective in deterring cartels and thereby increasing welfare. These features should thus be strengthened while those which deliver the opposite effect should be amended. For example, how many resources should be re-allocated away from industry screening and other detection methods towards prosecution, when a leniency policy starts generating many more cartel cases, if any? Is a leniency policy more effective in deterring cartels when sanctions are strengthened or when the probability of the cartel being discovered without a leniency application is higher?

These are not purely hypothetical questions and concerns. In 2006, for example, the Committee of Public Accounts in the United Kingdom said of the Office of Fair Trading's competition enforcement work that "The OFT has been too reliant on

---

Polinsky and S Shavell, 'The Economic Theory of Public Enforcement of Law' (2000) 38 *Journal of Economic Literature* 45. The social benefit of antitrust enforcement is therefore mainly determined by its deterrence effects. For an in-depth discussion, see P Buccirossi and others, 'Deterrence in Competition Law' in M Peitz and Y Spiegel (eds), *Analysis of Competition Policy and Sectoral Regulation* (Hanover, Now Publishers, 2014) (forthcoming).

[5] See JE Harrington Jr, 'When Is an Antitrust Authority Not Aggressive Enough in Fighting Cartels?' (2011) 7 *International Journal of Economic Theory* 39.

[6] To better see the discrepancy between social welfare and the objectives of law enforcement agencies that are evaluated or funded based on the number of convictions they obtain, consider the extreme case of a very effective enforcement regime that is able to completely deter wrongdoing at reasonable cost, thereby saving all litigation and prosecution costs. Social welfare would likely be maximised, but the law enforcement agency would then probably see a cut in its budget. In the absence of wrongdoing, there will be no successful convictions to demonstrate the need for and effectiveness of a well-funded agency.

complaints as a source for its competition enforcement work. The OFT should start a greater proportion of investigations on its own initiative, rather than waiting for a relevant complaint".[7] Yet to our knowledge there are no empirical grounds for supporting the Committee's assessment, and indeed, there is some experimental evidence against it that supports the Office of Fair Trading's strategy.[8]

Even if the total population of cartels were observable, or there were robust methods to infer the cartel population, many of these questions still could not be answered empirically. Only those policies that have actually been implemented can be evaluated empirically, not the infinite hypothetical variations in such policies that could actually prove much more effective. Together with the lack of observability of the overall population of cartels, this makes laboratory experiments an important complementary tool to gain empirical insight into the likely effects of leniency policies and other features of antitrust enforcement. Of course, laboratory experiments are always subject to stronger external validity caveats than empirical studies, particularly when used to approximate firm behaviour. But in the case of cartels and analogous crimes, laboratory experiments are particularly valuable and recent work on collusive corruption by Armantier and Boly seems to suggest that external validity concerns may not be too troublesome.[9]

In Part II, we review the empirical evidence on leniency policies, having regard to both descriptive and econometric studies. In Part III, we review the experimental evidence. Part IV concludes.

II Empirical Evidence on Leniency Policies

A Descriptive Studies

The empirical literature on leniency policies is recent and includes several papers which present and discuss descriptive statistics on prosecuted cartels.[10] A case study approach has also been used to examine leniency policies.[11]

---

[7] Committee of Public Accounts, *Enforcing Competition in Markets* (HC 2005–06, 841) 4, www.publications.parliament.uk/pa/cm200506/cmselect/cmpubacc/841/841.pdf.

[8] See J Hinloopen and AR Soetevent, 'Laboratory Evidence on the Effectiveness of Corporate Leniency Programs' (2008) 39 *RAND Journal of Economics* 607

[9] See O Armantier and A Boly, 'Comparing Corruption in the Lab and in the Field in Burkina Faso and in Canada' (2013) 123 *The Economic Journal* 573 https://docs.google.com/viewer?a=v&pid=sites&srcid=ZGVmYXVsdGRvbWFpbnxvbGl2aWVyYXJtY W50aWVyfGd4OjU5OTViZGNjNDA0NDAzMTI

[10] See M Bloom, 'Despite Its Great Success, the EC Leniency Programme Faces Great Challenges' in C-D Ehlermann and I Atanasiu (eds), *European Competition Law Annual 2006: Enforcement of Prohibition of Cartels* (Oxford, Hart Publishing, 2007); JM Connor, 'Global Antitrust Prosecutions of International Cartels: Focus on Asia' (2008) 31 *World Competition* 575; B Mihai, 'Cartels – Between Theory, Leniency Policy and Fines' (2008) 1(1) *Annals of Faculty of Economics* 549; M Carree, A Günster and MP Schinkel, 'European Antitrust Policy 1957—2004: An Analysis of Commission Decisions' (2010) 36 *Review of Industrial Organization* 97; E Combe and C Monnier, 'Fines against Hard Core Cartels in Europe: The Myth of Overenforcement' (2011) 56 *Antitrust Bulletin* 235; C Veljanovski, 'European Commission Cartel Prosecutions and Fines, 1998-2006: An Updated Statistical Analysis of Fines under the 1998 Penalty Guidelines' (2010) Case Associates, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1016014; JM Connor, 'Cartel Fine Severity and the European Commission: 2007-2011' (2013) 34 *European Competition Law Review* 58; O Dominte, D Şerban and AM Dima, 'Cartels in EU: Study on the Effectiveness of Leniency Policy' (2013) 8 *Management & Marketing* 529.

[11] Asker has made an in-depth analysis of a US parcel tanker shipping cartel and suggested that welfare-improving effects from leniency are linked to an increased probability of private antitrust suits.

A yearly analysis of leniency applications in the European Union (EU) and the US clearly shows that the number of cartels reported under a leniency policy and the number of individual leniency applications have both increased dramatically in recent years.[13] This is particularly the case in the EU. The generosity of the penalty reductions for initial and subsequent leniency applicants in the EU has also visibly increased.[14]

Table 1 below shows the most recent statistics on cartels prosecuted in the EU, the US, Asia and Russia. Between 1996 and March 2010, 124 firms were fined by the US Department of Justice for participation in 39 different cartels. In the EU, leniency applications in the period between 1998 and July 2011 related to 81 cartels, with a total of 385 firms. In Asia, 33 cartels were prosecuted by the Japan Fair Trade Commission, the Korea Fair Trade Commission and Taiwan's Fair Trade Commission between 1990 and 2007. Finally, 30 cartels were prosecuted in Russia between 2004 and 2011. Table 1 also shows that the average number of cartel members in the reported cartels is smallest in the EU (8.3) and largest in Russia (11), although the latter figure is inflated by a cartel involving 51 firms in the financial services between 2003 and 2008.

Repeat offenders are a highly debated issue.[15] Connor has suggested that there is evidence of a large amount of recidivism; he identified 389 recidivists worldwide in the period between 1990 and 2009.[16] This number constitutes 18.4 per cent of the total number of firms involved in 648 international hard-core cartel investigations and/or convictions. Werden, Hammond and Barnett have contested Connor's definition of recidivism and his calculation of the numbers of multiple and repeat offenders. The main discrepancy between the two arguments appears to be in how cartel members who merge and form a new firm are dealt with. Werden and others follow the legal practice (USDOJ and EC) and therefore, they have suggested that no repeat offenders in United States cartels have been fined since 1999.[17] As for the EU, one study identified 63 multiple offenders and six repeat offenders[18] since 1998 when the first leniency reduction was granted.[19] The first decision applying the leniency policy to a cartel case was in 1998, involving British Sugar.[20] The complaint was made in 1994 and, after the introduction of the leniency policy, all four cartel members applied for leniency. Three reductions of 10 per cent and one of 50 per cent were granted.

On average, a cartel member fined by the European Commission receives a leniency reduction of 26 per cent. Firms which receive a leniency reduction (1–99 per cent) receive first, on average, a fine increase of 32 per cent (these are granted for reasons such as recidivism, absence of co-operation, obstruction of the investigation and

---

See J Asker, 'Leniency and Post-Cartel Market Conduct: Preliminary Evidence from Parcel Tanker Shipping' (2010) 28 *International Journal of Industrial Organization* 407.

[13] See Connor, 'Cartel Fine Severity' (n 10) (US statistics); Dominte, Șerban and Dima (n 10) (EU statistics).

[14] See Dominte, Șerban and Dima (n 10).

[15] See GJ Werden, SD Hammond and BA Barnett, 'Recidivism Eliminated: Cartel Enforcement in the United States Since 1999' (Georgetown Global Antitrust Enforcement Symposium, Washington DC, 22 September 2011) 2, www.justice.gov/atr/public/speeches/275388.pdf, quoting MD Maltz, *Recidivism* (Orlando, Academic Press Inc, 1984) 54.

[16] See JM Connor, 'Recidivism Revealed: Private International Cartels 1991-2009' (2010) 6 *Competition Policy International* 101.

[17] See Werden, Hammond and Barnett (n 15).

[18] These are defined as any firm who was caught colluding after having received a fine for another cartel. In this sense, the definition is closer to Werden's than to Connor's.

[19] See C Marvão, 'The EU Leniency Programme and Recidivism' (2014) https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=IIOC2014&paper_id=517.

[20] information on the case available here:

http://ec.europa.eu/competition/antitrust/cases/dec_docs/33708/33708_6_7.pdf

for being the cartel ringleader or instigator) and a fine reduction of three per cent (for termination of the infringement at the time of the investigation, negligence as the cause of the cartel, limited involvement in the cartel, co-operation with the Commission outside the leniency policy, or proof of having been encouraged by public authorities or legislation).[21] The average firm which does not receive a leniency reduction has a fine reduction of 16 per cent and an increase of 56 per cent, whereas firms with immunity from fines would have faced, on average, a fine increase of 22 per cent and a decrease of three percent.

Although descriptive statistics (and case studies) are important to show correlations and trends, they fail to explain causality and thus the real effects of leniency. The real impact of the leniency policies can only be addressed with econometric methods, but methodological problems (such as potential sample selection bias from only observing detected cartels) and the lack of appropriate data make empirical research challenging. The results of econometric studies, considered next, must therefore be interpreted with some caution.

[TABLE 1 NEAR HERE.]

B Econometric Studies

i Deterrence Effects of Leniency Policies

As we suggested earlier in this chapter, the most important effect of leniency policies is deterrence, i.e., the resulting (hopeful) decrease in the number of cartels in society. However, this is very difficult to measure because only *detected* cartels are typically observed. Two main methodologies have been developed to infer the effects on cartel formation and deterrence of changing a law enforcement policy.

Harrington and Chang studied a dynamic model of cartel formation and showed that changes in the average duration of convicted cartels should follow a precise temporal pattern.[22] If the policy innovation is successful in increasing cartel deterrence, we should observe an increase in the average duration of convicted cartels in the short-run. This is because less stable cartels, with lower expected duration, immediately disintegrate; ensuing cartel detections will therefore come from a population of more stable cartels, which typically last longer. As a result, the cartel rate is reduced in the long-run.

The second methodology was derived by Miller, who developed a somewhat simpler dynamic model of cartel behavior from which he derived predictions for successful law enforcement innovations related to the temporal distribution of the number of detected cartels conditional on the leniency policy.[23] His model suggested that (a) an immediate increase in the number of detected cartels is consistent with the hypothesis that a leniency policy increases the probability of cartel detection; and (b) a

---

[21] The fine is adjusted according to aggravating and mitigating circumstances and the final value of the fine is capped at 10 per cent of the total turnover of the firm in the previous year. Special conditions are set in the case of inability to pay. For further information on cartel fines, see Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003 [2006] OJ C210/2.

[22] See M-H Chang and JE Harrington Jr, 'When Can We Expect a Corporate Leniency Program to Result in Fewer Cartels? ' (2014) http://assets.wharton.upenn.edu/~harrij/pdf/Leniency_08.11.14.pdf

[23] See NH Miller, 'Strategic Leniency and Cartel Enforcement' (2009) 99 *American Economic Review* 750.

subsequent decrease in the cartel detection rate and stabilization at a constant level lower than the one prevailing before the introduction of the leniency policy is consistent with it having a significant deterrence effect, that is, with the policy reducing cartel formation.[24] The first and only two studies of which we are aware that apply these methodologies to cartel data are studies by Brenner[25] and Miller[26] himself.

Brenner studied EU cartel cases in the period between 1990 and 2003, a dataset that included 61 cases. He tested the evolution of the average duration and number of cartels detected around and after the introduction of the first version of the EU leniency policy in 1996.[27] He found neither an increase in average duration after the introduction of the leniency policy nor an increase in the number of detected cartels immediately after the policy's introduction. And he did not find a decrease in the number of detected cartels in the longer run. These findings appear inconsistent with the theoretical conditions indicating that the 1996 leniency policy had positive deterrence effects.

While Brenner's conclusions are consistent with the general perception that the 1996 EU leniency policy was rather poorly designed and implemented[28] (it was reformed in 2002[29] and again in 2006[30]), it would be interesting to subject his findings to a number of robustness checks. For example, he treated the first three years of the leniency policy's existence as the short-run, but there is no clear definition from Miller's or Chang and Harrington's studies as to how the short-run should be defined. Hence, one would want to see analogous tests for a large number of other time frames to be confident about robustness.

Miller applied his own methodology to assess the effect of the reformed US leniency policy introduced in 1993.[31] He used data from the US Department of Justice that cover the period between 1985 and 2005. He found that the number of cartels detected by US authorities increased after the introduction of the new leniency policy, which according to his methodology is consistent with an increase in the cartel detection rate. He also observed that this increase was followed by a fall to a level below the pre-leniency policy level, a pattern that according to his theory is consistent with increased cartel deterrence. The mentioned changes in the number of detected cartels were statistically significant, of a large magnitude and consistent with several robustness checks.

Although Miller's study probably represents the most important contribution to the empirical literature on the effects of leniency policies to date, it has not escaped criticism. Cartel formation and dissolution are not endogenised in the model (although this seemed to be present in an earlier draft of the paper).[32] and the changes in the cartel duration of detected cartels were not considered as a robustness check.

De also tested Harrington and Chang's theory.[34] The paper focused on the precise determination of the life-span of 109 EU cartels that were the subject of an

---

[24] See ibid 751–52, 756, 758, 765.

[25] See S Brenner, 'An Empirical Study of the European Corporate Leniency Program' (2009) 27 *International Journal of Industrial Organization* 639.

[26] See Miller (n 23).

[27] See Commission Notice on the non-imposition or reduction of fines in cartel cases [1996] OJ C207/4.

[28] See Bloom (n10).

[29] See Commission Notice on Immunity from fines and reduction of fines in cartel cases [2002] OJ C45/3.

[30] See Commission Notice on Immunity from fines and reduction of fines in cartel cases [2006] OJ C298/17.

[31] See US Department of Justice, 'Corporate Leniency Policy' (10 August 1993) www.justice.gov/atr/public/guidelines/0091.pdf.

[32] *cf* Chang and Harrington (n 22).

[34] See O De, 'Analysis of Cartel Duration: Evidence from EC Prosecuted Cartels' (2010) 17 *International Journal of the Economics of Business* 33.

infringement decision between 1990 and 2008. Previous empirical studies on cartel duration used methods which assumed a normal distribution of the lifetime data, and they were unable to deal with a flexible probability of exit from a cartel or with more than one reason for a cartel breaking up. To overcome both of these issues, De analysed the dataset with the help of a competing risk Cox proportional hazard model. The regression results showed that the introduction of a leniency policy was one of the causes of cartel breakdown. De argued that it is extremely difficult to empirically define the short- and long-run and so her model refrains from doing so. Nonetheless, her results showed that cartels detected after the introduction of the initial leniency policy in 1996 had a lower survival probability than those cartels that were detected earlier. According to Harrington and Chang's model, this finding is not consistent with an increase in deterrence linked to the leniency policy.

Zhou applied Harrington and Chang's model to EU leniency policy data for the period between December 1985 and December 2011.[35] Using hazard model regression estimates, he found that cartel durations increased significantly in the period immediately following the introduction of a leniency policy (consistent with enhanced detection) and subsequently fell below short-run levels (consistent with enhanced deterrence). In addition to providing results supportive of the 2002 EU leniency policy, Zhou's paper also tried to improve methodologically on previous work. He argued that De did not differentiate the short-run from the long-run impacts and that Brenner took the first three years of the leniency policy's existence as the short-run[36] without theoretical support for doing so. Zhou differentiated the impacts by cartel start date, which is more in line with Harrington and Chang's model: the short-run impact arises only with cartels that started before the introduction of the leniency policy, and the long-run impact arises only with cartels born after its introduction.

Klein tried to identify the deterrence effects of leniency policies by directly linking their introduction to an indicator of competition intensity.[37] His empirical analysis relied on Organisation for Economic Co-operation and Development data for the period between 1990 and 2010 and included 23 countries. He calculated the average profitability of industries (quotient between value added and cost of capital and labour), which he then used to draw inferences about the price-cost margin, since both are directly related. Issues of sample selection bias, endogeneity and omitted variables were addressed through the use of additional control variables (changes in GDP trend, in imports and in import penetration), an instrumental variable estimation and several robustness tests. The results showed that leniency policies were associated with a decrease in the price-cost margin of three to five per cent. Unfortunately, the interpretation of the average profitability of industries is multi-faceted and its correlation with competition intensity is not entirely clear, particularly in cases of severe industry restructuring.

Finally, Yusopova has presented the first econometric assessment of the leniency policy that was introduced in Russia in 2007.[38] The perceived ineffectiveness

[35] See J Zhou, 'Evaluating Leniency with Missing Information on Undetected Cartels: Exploring Time-Varying Policy Impacts on Cartel Duration' (2013) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1985816&download=yes.

[36] See Brenner (n 25) 643.

[37] See GJ Klein, 'Cartel Destabilization and Leniency Programs – Empirical Evidence' (2011) ZEW Discussion Paper No 10-107, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1854426.

[38] See G Yusupova, 'Leniency Program and Cartel Deterrence in Russia: Effects Assessment' (2013) National Research University Higher School of Economics Basic Research Program Working Paper No WP BRP 06/PA/2012, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2348596. The leniency policy

of the leniency policy led to a reform in 2009, when full immunity and criminal liability were introduced.[39] The data included all 30 cartels which were fined between 2004 and 2011. There were up to 51 firms per cartel. The results from a Poisson regression showed that the 2009 revision of the leniency policy was associated with a decrease in both the size of detected cartels and their duration. The results also showed that industries[40] with low concentration have had fewer cartel convictions since the leniency policy has been in place. Yusopova concluded that the 2009 revision was effective. Harrington and Chang's theory would suggest the opposite, however: a decrease in the duration of detected cartels is consistent with the new policy causing a reduction in cartel deterrence.

ii Other Issues Related to Leniency Policies

In his 2009 study, Brenner also estimated the factors that influence the absolute amount of the fine (and the fine reduction) and the duration of the investigation.[41] Using Ordinary Least Squares estimations, Brenner showed that the leniency policy increased the average reduced and total fines by around €16.5 million and €30.9 million respectively. Furthermore, the introduction of the leniency policy decreased the average duration of cartel investigations by around 1.48 years. The duration of the cartel and the number of firms and countries involved in each seemed to play no role in determining the fine, the fine reduction and the duration of the investigation. However, the number of cartel members presented a negative coefficient in the model for investigation duration.

While these extra results advance our knowledge on the effects of the 1996 EU leniency policy, Brenner's analysis could be improved by using a data deflation process for the absolute amount of the fine and by weighting the absolute value of the fines with the turnover of the firms in the cartel.

A later paper by Brenner[42] examines the resource advantage of leniency applicants. Using the same dataset, the author uses a logit model to establish the differences in the decision to report, between large multinational and other firms. The results show that the former are more likely to report and cooperate with an investigation but no other characteristics of reporting and cooperating firms are identified as being significant.

---

was established by Federal Law No 45 'On Amendments to the Russian Federation Code of Administrative Offences'.
A previous discussion of the Russian LP is carried in A Shastitko and S Avdasheva, 'Introduction of Leniency Programs for Cartel Participants: The Russian Case' (2011) *Antitrust Chronicle*, **8**, number 2: https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=IIOC2012&paper_id=28
[39] See Code of the Russian Federation on Administrative Violations, art 14.32 notes (civil liability); Criminal Code, art 178 note 3 (criminal liability). See generally Federal Antimonopoly Service of the Russian Federation, 'Report Cartel Collusion!', http://en.fas.gov.ru/report-cartel-collusion/; D Yeremin, A Subbot and M Mouradov, 'Russia' in SJ Mobley and R Denton (eds), *Global Cartels Handbook: Leniency: Policy and Procedure* (Oxford, Oxford University Press, 2011).
[40] The 7 industries are defined according to the cartel reports from the Federal Antimonopoly Service and the concentration of each industry is categorized into high, medium or low.
[41] See Brenner (n 25).
[42] See S Brenner, 'Self-disclosure at international cartels' (2011) 42 *Journal of International Business Studies 221*.

A master's thesis by Arlman presented a second analysis of the EU leniency policy of 1996.[43] A dataset of 67 cartel cases (being all those cartel cases in the period between 1990 and 2004 in which the European Commission imposed a fine) was used to test the determinants of the number of words in a decision (as a proxy for the amount of information in the Commission's possession), the amount of the reduced fine and the gravity of the infringement. Arlman found that the leniency policy, measured by a dummy for whether or not a firm received maximum leniency, is positively correlated with the number of words in a decision and the gravity of the infringement. In line with Brenner's finding, the paid fine was also found to be higher once the leniency policy was introduced, although Arlman measured the paid fine as a share of the firm's turnover, which is problematic because it creates a bias between more and less diversified firms. Given that the introduction of the leniency policy seemed to shorten investigations, increase fines and increase the amount of content (words) in the ultimate decision, the author concluded that the leniency policy was moderately effective in this sense.

Gärtner and Zhou focused on the delay with which a cartel is reported relative to the time of collapse of the cartel.[44] They analysed 96 EU cartel cases, of which 78 included leniency applications. Between July 1996 and 2006, 40 per cent of the leniency policy applications experienced delays, often longer than 10 months, relative to the time of collapse of the cartel. A hazard model, where spells correspond to periods of application delay, was used in the analysis of the leniency application. They found that the introduction of the EU leniency policy in 2002 had a negative effect on the decision to apply for leniency. Delayed leniency applications were also shown to be correlated with the severity of the punishment and with business cycles. These results were corroborated by Probit model estimates and robustness checks.

One of the present authors has provided a more recent assessment of the EU leniency policy by examining the factors that encourage cartel members to self-report.[45] The self-compiled data employed in the empirical analysis included all cartels up to July 2011 where there was at least one successful leniency policy application (81 cartels involving 385 firms). The study distinguished firms that started to participate in a cartel after being previously fined (2), those which ended their collusive behaviour after being fined for participating in another cartel (4) and firms which ended their participation in a cartel after being investigated for a second cartel of which they were a participant (22). A total of 63 firms participated, contemporaneously or not, in at least two cartels (that is, they were multiple offenders). The econometric analysis, using Tobit and IV models, showed that the first reporter received much higher fine reductions, whether or not the reporting of the cartel took place before the European Commission started an investigation. The predicted leniency reductions were also larger for firms in smaller cartels, in cartels with a wide geographical impact and for firms which receive lower fine reductions outside the leniency policy. The main result of this study is that repeat offenders appeared to receive higher leniency reductions, which suggests that firms can learn the 'rules of the game', repeatedly colluding and reporting the cartel, and thus substantially damage their partners.

---

[43] See S Arlman, 'Crime but No Punishment: An Empirical Study of the EU's 1996 Leniency Notice and Cartel Fines in Article 81 Proceedings' (MSc thesis, University of Amsterdam, 2005) www.arlman.demon.nl/sjoerd/leniency.pdf.

[44] See DL Gärtner and J Zhou, 'Delays in Leniency Application: Is There Really a Race to the Enforcer's Door?' (2012) GESY Discussion Paper No 395, www.sfbtr15.de/uploads/media/395.pdf.

[45] See Marvão, 'The EU Leniency Programme and Recidivism' (n 19).

In a subsequent paper, one of the present authors studied the characteristics of the firms reporting under the leniency policy and the cartels in which they take part.[46] Probit estimates were carried out using self-collected EU data as in the earlier study[47] together with US data from John Connor's private international cartel database. In the US in the period between 1984 and 2009, 2310 firms were convicted for their participation in cartel activities. The empirical analysis showed that EU firms that report the cartel and receive immunity from fines under the leniency policy are typically repeat or multiple offenders and are less likely to have received other fine reductions, while in the US the reporting firms are more likely to be the cartel leader as defined in Connor's database[48]. Repeat offenders were also more likely to receive immunity if they report once the collusive agreement ended. In contrast, firms which received other reductions were less likely to apply for and be granted immunity if the cartel is over.[49]

Some of the characteristics of the cartels in which pre-investigation reporting occurs were also unveiled. In the EU, these cartels tended to be smaller in terms of the number of members (and also number of repeat and multiple offenders) and tended to impact a geographical area wider than the European Economic Area. Reporting was also more likely to occur in the fine art auctions sector, which has a small number of firms and where reporting will significantly damage the competitors that also took part in the cartel. In the US, the predicted probability of immunity was much larger in the rubber and plastic sector and the paper and printing sector, and in markets with a moderate number of buyers.

[TABLE 2 NEAR HERE.]

III Experimental Evidence on Leniency Policies

As previously discussed, cartels, like other white collar crimes, typically are not observed unless they have been detected. Since every instance of collusion cannot be observed, interpreting an increase in the number of convicted cartels following a policy innovation as a 'success' — an interpretation adopted by some in relation to the reform of the US leniency policy in 1993[50] — is an elementary logical mistake. An increase in the number of convictions may be generated by an increase in cartel formation itself the result of more lenient law enforcement. As noted in Part IIB, complex empirical methods need to be employed to try to understand whether the increased number of convicted cartels is associated with a fall or an increase in the total amount of such crimes in society. Not only are such studies necessarily complex and indirect (since the population of cartels is not directly observable, as is the case e.g. for violent crimes,

---

[46] See C Marvão, 'Heterogeneous Penalties and Private Information' (2014) Konkurrensverket Working Paper Series in Law and Economics Working Paper 2014:1, www.kkv.se/upload/Filer/Trycksaker/Rapporter/WorkingPaper/working_paper_2014-1.pdf.

[47] See Marvão, 'The EU Leniency Programme and Recidivism' (n 19).

[48] This result contrasts with the US leniency policy's statement that ringleaders cannot receive leniency (see US Department of Justice (n 31) 2), which suggests that different definitions of ringleaders are used, or that the rule is not always enforced. Connor's database (used in the analysis) identifies the leader in each cartel, according to US Department of Justice reports, as a 'cartelist mentioned in decision as a ringleader or a history of the case says one cartel member was the cartel disciplinarian/bully'.

[49] After Marvao's paper was widely circulated, a later paper uses the same EU specification on a shorter dataset and finds the same results. See C Hoang, K Huschelrath, U Laitenberger and F Smuda, 'Determinants of self-reporting under the European corporate leniency program' (Forthcoming).

[50] See DOJ ´Corporate Leniency Policy´ (1993) http://www.justice.gov/atr/public/guidelines/0091.htm

most of which are reported), they are also of somewhat limited value when attempting to evaluate the effects of different policy designs which have not yet been implemented. Laboratory experiments are thus a crucial complementary empirical method because they overcome these drawbacks. They allow behaviour to be observed in a controlled environment, including changes in the rate of overall cartel formation, and different policy designs to be tested at a reasonable cost.

Obviously, laboratory experiments themselves have several well-known drawbacks that offset their advantages to some extent. The results of laboratory experiments must therefore be carefully examined, particularly when assessing firm behaviour based on the behaviour of subjects in the laboratory. Because subjects are typically students and interaction is artificially simulated, the external validity of the results achieved cannot be taken for granted. With this caveat in mind, the following section reviews the available evidence from laboratory experiments on leniency and whistleblowers in competition law.

A Leniency, Rewards, Cartels and Prices: Early Studies

The first laboratory experiment on leniency policies of which we are aware was carried out by Apesteguia, Dufwenberg and Selten.[51] They studied competitive outcomes in a one-shot homogeneous good Bertrand oligopoly with three firms and a discrete demand function. They embedded this market game in four legal frameworks: Ideal, Standard, Leniency and Bonus. In the 'Ideal' framework, there was no antitrust law and communication across competitors (forming cartels) was not possible. In 'Standard', convicted firms faced fines equivalent to 10 per cent of their revenue (accordingly, no fines were imposed if the firm has no revenue). In 'Leniency', firms which reported their participation in a cartel received a fine reduction (if they had some revenue and therefore faced a positive fine). And in 'Bonus', reporting cartel members received part of the fines paid by other firms as a reward. In this set up (homogeneous Bertrand and fines set at 10 per cent of revenue), if a cartel member defected, its partners had zero revenue and therefore faced zero fines. For this reason, the presence or absence of leniency made no difference in terms of incentives to report, and strategically equivalent collusive sub-game perfect equilibria existed both in 'Standard' and 'Leniency', sustained by the threat of reporting if a defection occurs. However, in 'Leniency', collusion was only sustained in dominated strategies.

The experimental analysis which tested the effects from the theoretical model confirmed that agents understand and use the threat of reporting to sustain collusion, more so in 'Standard' than in 'Leniency', where both market prices and the percentage of cartel formation were lower. Additionally, 'Leniency' was the framework which minimized the share of cartel formation. The analysis also did not find that deterrence increases with the introduction of rewards, since the 'Bonus' framework presented the highest levels of market prices and cartel formation. However, in 'Bonus', incentives to report were stronger and there were no collusive equilibria sustained by the threat of reporting, as were present in the other treatments. This may suggest that the counterintuitive finding may not hold if subjects are allowed to gain experience. This leaves some space for follow-up work.

The stylised framework and particular set-up used in this pioneering study raises some issues for the interpretation of its results. The oligopoly game in the experiment allowed for only one round of decisions, leaving agents no opportunity to learn the

[51] See J Apesteguia, M Dufwenberg and R Selten, 'Blowing the Whistle' (2007) 31 *Economic Theory* 143.

game. Coupled with the subtlety of the differences between 'Standard', 'Leniency' and 'Bonus', it is possible that some of the counterintuitive results, such as agents not reacting to rewards, were driven by subjects not fully grasping the situation.

While Apesteguia, Dufwenberg and Selten's study tests the empirical relevance of theory, Hinloopen and Soetevent approach the same issue but with a different methodology so as to make the lab look like the real world and thus, derive insights by analogy..[52] They repeated the underlying oligopoly game and controlled for communication, allowing it in different degrees of a range of electronically accepted market prices. Subjects were also free to choose whether or not to agree on a collusive price. When leniency was introduced, cartel members could only report and obtain a fine discount before an investigation was initiated. The first reporting party received full immunity and the second a 50 per cent fine reduction; the remainder received no fine reduction at all. In this way, the study addressed both direct general deterrence and desistance effects. The study used the oligopoly model from Apesteguia, Dufwenberg and Selten's study as a stage game of a repeated game with an uncertain horizon, and added a small fixed cost of reporting to the legal framework. This cost was present even when revenue was zero because competition is à la Bertrand and a cartel partner undercut and took all customers. Although an additional fixed cost/fine, limited to no-leniency treatments, would have further approximated real world conditions, this positive reporting cost partly captured the real world feature that, absent a leniency policy, a cheated-upon cartel member which reports is still subject to a fine. In this more realistic framework, the study confirmed the potential of the positive ex ante deterrence effects of the US leniency policy, restricted to the first 'spontaneously' reporting party.

Contrary to what the first models of leniency assumed,[53] Hinloopen and Soetevent showed that substantial cartel deterrence can be achieved with the introduction of a leniency policy that is only available to spontaneous reports before an investigation is opened. The average price in 'Leniency' is significantly lower because cartels which do form are less successful in charging prices above the Nash equilibrium and because of the lower rate of decisions in favour of price discussions. This leads to a higher rate of defection and of price undercutting. Therefore, significantly fewer cartels are established and the life-span of cartels that were not deterred is reduced.

A second notable result of the study is that there exists a constant high rate of recidivism —the same percentage of detected and convicted cartels start colluding again, after some time, with or without leniency policies. Desistence (that is, specific deterrence) is not effective. The lack of desistance effects implied by recidivism may be a consequence of the absence of higher fines or the higher probability of detection for repeat offenders. Therefore, after a conviction, collusion remains practically as attractive as before for the convicted cartel. Unfortunately, the study did not consider rewards.

The above mentioned studies focus on non-exploitable leniency policies.[54] In another study by Hinloopen and Soetevent,[55] they used a similar setting (repeated Bertrand game, where subjects report before an investigation) but restricted it to a

---

[52] See Hinloopen and Soetevent (2008), (n 8)

[53] See, eg, M Motta and M Polo, 'Leniency Programs and Cartel Prosecution' (2003) 21 *International Journal of Industrial Organization* 347.

[54] On exploitable leniency policies, see G Spagnolo, 'Divide et Impera: Optimal Leniency Programs' (2005) CEPR Discussion Paper No 4840, http://ftp.zew.de/pub/zew-docs/veranstaltungen/rnic/papers/GiancarloSpagnolo.pdf.

[55] See J Hinloopen and AR Soetevent, 'From Overt to Tacit Collusion: Experimental Evidence on the Adverse Effects of Corporate Leniency Programs' (2008) Tinbergen Institute Discussion Paper TI 2008-059/1, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1146347.

duopoly where communication was done through coloured cards. They introduced an 'exploitable' (overly generous) leniency policy treatment where agents could self-report and receive immunity from fines if they were the only reporter and a 90 per cent reduction where they both reported. There were no penalties in the 'benchmark' treatment, while in 'Antitrust', cartels were detected with a 40 per cent probability (much higher than the 15 per cent in their other study) and they paid a fine equal to the cartel gains (compared to 10 per cent of the revenue over the same period as in their other study). This simpler setting, compared to their other study, allowed Hinloopen and Soetevent to isolate the effects of exploitable leniency policy treatments and non-exploitable leniency policy treatments.

The results in the paper showed that when there is an exploitable leniency policy, it is in fact exploited; 70 per cent of the pairs reported simultaneously and there was some evidence that overt collusion became more appealing. It was also shown that a non-exploitable leniency policy treatment leads firms to turn to tacit collusion, which is not illegal and is thus free from fines. The non-exploitable leniency policy treatment led to an increase in overt collusion but of a much smaller magnitude than the exploitable leniency policy. The non-exploitable leniency policy treatment's earnings were larger than in the benchmark treatment and no lower than in the exploitable leniency policy treatment. In conclusion, in this experiment, leniency policies always reduce welfare.

Hamaguchi, Kawagoe and Shibata considered the effects of cartel size (in terms of the number of members), the fine schedule and the degree of leniency (partial reduction, immunity or rewards) on the likelihood that a cartel is reported.[56] In this study, subjects did not play a market game and did not chose prices or quantities. All subjects were initially assumed or forced to be part of a cartel, but were given incentives to maintain collusion. The players were then left with the choice of whether to report collusion or not under different treatments, in which the leniency program is not necessarily strong enough to dissolve cartels. It was further assumed that cartels that are reported do not form again. The study found that the initial cartel was reported more frequently when the number of members was higher and that the frequency of reporting was not affected by either the fine schedule nor or by whether only the first party or all parties that self-report were eligible for leniency. The study also found that the possibility of reporters receiving a reward had a large positive impact on dissolving cartel activity.

While these results on the likelihood of reporting are in themselves interesting, their interpretation in terms of the effects of leniency policies and their possible policy prescriptions is somewhat problematic. What matters for welfare is deterrence and prices, not the number of reports, which by themselves increase the workload of competition authorities and prosecution costs[57]. Experiments that include a market game[58] show that there is a strong interdependence between the legal environment and the way firms behave in the market. This interaction is excluded by construction in the study by Hamaguchi, Kawagoe and Shibata. Therefore, it is not known if these reporting patterns would change if subjects were also involved in a market game as in

---

[56] See Y Hamaguchi, T Kawagoe and A Shibata, 'Group Size Effects on Cartel Formation and the Enforcement Power of Leniency Programs' (2009) 27 *International Journal of Industrial Organization* 145.

[57] We recognize that self-reporting increases cartel convictions, which is particularly advantageous in the case of a limited number of investigating officers. However, the ultimate focus of competition authorities should be improving welfare by increasing cartel deterrence and lowering prices.

[58] See, eg, Hinloopen and Soetevent, 'Laboratory Evidence' (n 52).

reality. Also, ex ante deterrence effects and prices cannot be studied in this experiment because there is no cartel formation stage and no pricing decisions before or after the reporting stage.

B Deviations, Pre-Emption and the Level of Fines: Reaching the First Best

In Hinloopen and Soetevent's first study,[59] subjects could report only in a simultaneous stage that took place after price choices were made public. Given this set-up of the study, it was not possible for a cartel member that decides to abandon the cartel to 'rush to the courtroom' before other cartel members realise they intend to do so. And it was therefore not possible to stop colluding and self-report before an opponent realises that one of the cartel members wants to stop colluding and self-report. Yet this is a crucial feature of real world leniency policies, both according to practitioners[60] and according to theory: the 'protection from punishment' effect[61] and the 'race to the courtroom' effect'[62] are severely limited by the impossibility of deviating from the cartel's price and reporting before the opponent realises that deviation took place. Moreover, most leniency policies require the cessation of collusive conduct when applying for leniency, while the leniency application is kept secret (unless another firm applies) for quite some time so as to allow the competition authority to prepare for dawn raids and other actions. This means that leniency policies *require* secret deviation when secretly applying for leniency, — something Hinloopen and Soetevent excluded. Finally, the fact that applications for leniency can only be submitted after the prices set by all competitors become public information makes the possibility of using leniency to punish price deviations particularly salient. As some have theorised, this may unduly enhance cartel stability.[63]

To overcome these problems, which make it difficult to relate Hinloopen and Soetevent's results to real world leniency policies, Bigoni and others developed a dynamic experimental setting in which parties could apply for leniency, either before or after the price choices were observed by all players, in each stage game.[64] This timing allowed a subject that wants to leave the cartel to both stop colluding on prices and apply for leniency confidentially before the other cartel members realise, as is possible in reality. This timing captured the 'race to the courtroom' and 'protection from punishment' effects (if you deviate on the price, you can apply for leniency at the same time so your competitors cannot punish your deviation by applying for leniency after they observe it). It also made it possible to disentangle and quantify reports linked to defections and reports linked to punishments. The set-up also adopted a re-matching

---

[59] See ibid.

[60] See, eg, SD Hammond, 'Detecting and Deterring Cartel Activity through an Effective Leniency Program' (International Workshop on Cartels, Brighton, 21–22 November 2000) www.justice.gov/atr/public/speeches/9928.pdf; Hammond, S., 2004. Cornerstones of an effective Leniency Program. Presented at the ICN Workshop on Leniency Programmes (November 2004). DOJ Discussion papers; SD Hammond, 'Cornerstones of an Effective Cartel Leniency Programme' (2008) 4(2) *Competition Law International* 4.

[61] See Spagnolo, 'Divide et Impera' (n 54).

[62] See JE Harrington Jr, 'Optimal Corporate Leniency Programs' (2008) 56 *Journal of Industrial Economics* 215.

[63] See Spagnolo, 'Divide et Impera' (n 54).; P Buccirossi and G Spagnolo, 'Leniency Policies and Illegal Transactions' (2006) 90 *Journal of Public Economics* 1281.

[64] See M Bigoni and others, 'Fines, Leniency, and Rewards in Antitrust' (2012) 43 *RAND Journal of Economics* 368; M Bigoni and others, 'Trust, Leniency and Deterrence: Evidence from an Antitrust Experiment' (2012), http://ibe.eller.arizona.edu/docs/papers/2013/bigoni_Trust_Leniency_Deterrence_2012_10_30.pdf.

methodology developed in the literature on experimental repeated games that allows subjects to face a constant discount factor and, most crucially, to play several supergames and learn.[65] It simplified the framework by using fixed fines so as to be able to control subjects' expectations on their level and how these change across treatments. The impact of these expectations on the effectiveness of leniency policies could therefore be studied.[66] Bigoni and others also used a differentiated price game to avoid the non-generic and unrealistic discontinuities of the homogeneous-good Bertrand game (where a deviation implies zero profits — and in previous experiments zero fines — for all other firms), and a duopoly to minimise the risk highlighted by Holt that, with more than two subjects, punishment of deviators — which is crucial in studies of collusion — is biased or softened by the concern that the other, innocent subject will also be harmed by the punishment.[67]

Bigoni and others used this set-up to study how standard antitrust enforcement (without leniency), leniency policies and monetary rewards for the first reporting party affect cartel formation and prices.[68] They found that antitrust enforcement without leniency reduces cartel formation but increases cartel prices: subjects use costly fines as punishments against deviators. Leniency improves antitrust enforcement by strengthening deterrence, as fewer cartels are formed and existing cartels that are detected through leniency do not form again (leniency eliminates recidivism[69]). However, leniency policies also stabilise surviving cartels: subjects appear to anticipate the lower post-conviction prices and lack of recidivism after self-reports or leniency. Therefore, overall average prices do not fall significantly. Conversely, with rewards, prices rapidly fall to the competitive level. Overall, the results suggest a strong cartel deterrence potential for well-run leniency policies, where firms self-report before an investigation is opened. The results also suggest rewards be introduced to obtain substantial welfare gains in terms of lower prices.

In a subsequent study, Bigoni and others used this same set-up to study the effect of separately changing the level of the fines and the probability of exogenous detection on cartel deterrence, with and without leniency.[70] For occasional crimes committed by single and risk-neutral subjects, changing the mix between fines and exogenous probability of detection, keeping the expected fine constant, should not affect deterrence. The paper developed a model showing that in a dynamic multi-agent set-up, this equivalence is lost and fines are much more important with leniency. The experiment confirmed the theoretical finding. Without leniency, the probability of

---

[65] See, eg, P Dal Bó, 'Cooperation under the Shadow of the Future: Experimental Evidence from Infinitely Repeated Games' (2005) 95 *American Economic Review* 1591; M Blonski, P Ockenfels and G Spagnolo, 'Equilibrium Selection in the Repeated Prisoner's Dilemma: Axiomatic Approach and Experimental Evidence' (2011) 3 *American Economic Journal: Microeconomics* 164; P Dal Bó and GR Fréchette, 'The Evolution of Cooperation in Infinitely Repeated Games: Experimental Evidence' (2011) 101 *American Economic Review* 411; M Bigoni and others, 'Time Horizon and Cooperation in Continuous Time' (2014) http://web.stanford.edu/~skrz/BigoniCasariSkrzypaczSpagnolo.pdf.

[66] When fines are set as a share of the profits realised n previous period, as in Hinloopen and Soetevent, 'Laboratory Evidence' (n 52), it is hard for subjects to predict what the fine will be and for the experimenter to control for what subjects' expectations are, because cartels are often detected and fined after they have stopped sustaining high prices. The fine is often therefore a fraction of competitive, rather than collusive, profits. This feature makes it impossible to control for the level of fines and study how this interacts with the leniency policy.

[67] See CA Holt, 'Industrial Organization: A Survey of Laboratory Research' in JH Kagel and AE Roth (eds), *The Handbook of Experimental Economics* (Princeton, Princeton University Press, 1995).

[68] See Bigoni and others, 'Fines, Leniency, and Rewards in Antitrust' (n 64).

[69] Against Hinloopen and Soetevent, 'Laboratory Evidence' (n 52).

[70] See Bigoni and others, 'Trust, Leniency and Deterrence' (n 64).

exogenous detection and fines both have similar effects for deterrence. With leniency policies in place, the absolute level of the fine is much more important in producing deterrence, while the probability of exogenous detection becomes practically irrelevant. This indicates that deterrence is mainly driven by 'distrust' or strategic risk, that is, by the fear of partners deviating and reporting. This study even found a large deterrence effect of fines in the presence of a leniency policy when the probability of exogenous detection is zero. As theorised by one of this chapter's authors,[71] this implies that the 'distrust' deterrence channel is powerful and that the first best (full deterrence with zero deadweight/inspection costs) could now be achieved at finite levels of fines. It also implies that recently voiced concerns[72] that the large number of leniency applications may be reducing antitrust effectiveness by exhausting the resources of competition authorities, making it impossible for them to undertake random industry audits, may be misplaced. On the contrary, these findings suggest that the efficiency of competition law enforcement can be considerably improved by strengthening sanctions and the management of the leniency policy while reducing the expenditure of competition authorities' resources on random inspections.

Of course, it is important to ensure that these results are robust before translating them into policy prescriptions. Positive news in this respect is found in a very recent experiment by Chowdhury and Wandschneider.[73] This study also considered the effect of changing the mix between fines and the exogenous detection probability in the absence and presence of a leniency policy, as studied by Bigoni and others,[74] although it did not consider the case of zero probability of detection. This paper uses an environment similar to the one in Hinloopen and Soetevent's work,[75] where matching was fixed and cartels could only be reported after price choices were made public, so that — as in Hinloopen and Soetevent's work — the 'protection from punishment' and 'race to the courtroom' effects could hardly be active. Bigoni and others' finding was confirmed by this experiment: increasing the absolute fine and reducing the probability of exogenous detection (absent self-reporting) increased the deterrent effect of leniency policies in this environment also. The conclusion that the efficiency of competition law enforcement can be improved by strengthening sanctions and the management of the leniency policy while reducing competition authorities' efforts in conducting random inspections of industries seems rather robust.

C Additional Issues

i Ringleaders

One debated issue is whether ringleaders should be excluded from leniency policies (as is in the US) or included (as in the EU). On the one hand, excluding ringleaders from the leniency policy may increase deterrence by introducing 'free riding' on who should lead. Excluding ringleaders may discourage firms from taking the lead and induce them to wait for others to do so, thereby delaying and reducing cartel formation. On the other

---

[71] See Spagnolo, 'Divide et Impera' (n 46).

[72] See R Abrantes-Metz ´Proactive vs Reactive Anti-Cartel Policy: The Role of Empirical Screens´ (2013). http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2284740 , among others.

[73] See SM Chowdhury and F Wandschneider, 'Anti-Trust and the "Beckerian Proposition": The Effects of Investigation and Fines on Cartels' (2013) CCP Working Paper 13-9, http://competitionpolicy.ac.uk/documents/107435/107587/13-9+complete.pdf/e5fca5ce-fb9a-4766-8289-14e9cde55b58.

[74] See Bigoni and others, 'Trust, Leniency and Deterrence' (n 64).

[75] See Hinloopen and Soetevent, 'Laboratory Evidence' (n 52).

hand, this policy may reduce deterrence by creating one firm that can be trusted by the others as it will never (be able to) 'run to the courtroom' and report them.

Bigoni and others undertook a preliminary investigation of this trade-off by introducing treatments where the ringleader, defined as the subject that first asked the others to communicate, could not apply for leniency.[76] This was announced to subjects, who therefore knew that they would lose the opportunity to receive leniency if they communicated first. The authors found that in treatments where the initiator of the cartel could not apply for leniency, the deterrence effect of leniency is unaffected, although prices increase. They argued, however, that this was a preliminary result that should be treated with caution, as the experimental set-up was not explicitly designed to address this question and was particularly unfavourable to excluding ringleaders. With a duopoly, excluding the ringleader leaves only one party able to report and obtain leniency, which eliminates the fear of others reporting that is, according to one of the present authors,[77] a crucial determinant of deterrence. Bigoni and others therefore invited more work on the subject. The invitation was taken up by a number of authors.

Hesch used a simplified version of Hinloopen and Soetevent's study[78] where reporting could only take place after price choices became public and where liability expired after each period.[79] He introduced a ringleader role, which was assigned randomly by a computer in each period. It was found that, in treatments where the randomly assigned ringleader was not allowed to apply for leniency, cartel formation was more intense and prices were higher. Unfortunately, an exogenous and random assignment of the role of ringleader eliminates, by design, co-ordination problems in the formation of the cartel, which is where a positive effect of excluding ringleaders could occur. By removing the possibility that co-ordination issues could be worsened by the exclusion of ringleaders, inducing subjects to delay or avoid taking the lead hoping that others would do it first, the experiment allowed for only the negative effects of the policy. This reduces the validity of the result.

Wandschneider improved the mechanism to identify the leader.[80] In his set-up, the ringleader was the subject whose suggested cartel price during the communication stage had been accepted by the two other group members. As in earlier work,[81] this made the identity of the (at least partial) leader endogenous. A form of 'free riding effect' could then in principle present itself, not in the form of delayed or reduced cartel formation but in the form of lower prices suggested by those who do not want to be the leader, which could possibly induce lower cartel prices.

The study found that more cartels are formed when the leader is not able to obtain leniency. However, it also found that prices do not increase when ringleaders are excluded from the leniency policy, which might be due to the above mentioned free riding effect. An in-depth analysis of behaviour in the price proposal stage is needed to verify this conjecture. Finally, it found that ringleader exclusion destabilises the collusive agreement, as more firms deviate. This was expected, as this study follows Hinloopen and Soetevent[82] in only allowing applications for leniency after price

---

[76] See Bigoni and others, 'Fines, Leniency, and Rewards in Antitrust' (n 64).

[77] See Spagnolo, 'Divide et Impera' (n 46).

[78] See Hinloopen and Soetevent, 'Laboratory Evidence' (n 52).

[79] See M Hesch, 'The Effects of Ringleader Discrimination on Cartel Stability and Deterrence – Experimental Insights' (2012) 3(1)(5)) *Journal of Advanced Research in Law and Economics* 26.

[80] See F Wandschneider, 'An Experimental Study of Ringleader Exclusion from Leniency Programmes' (PhD thesis, University of East Anglia, 2014) ch 3. https://ueaeprints.uea.ac.uk/49483/1/Thesis_Wandschneider2014.pdf

[81] See Bigoni and others, 'Fines, Leniency, and Rewards in Antitrust' (n 64).

[82] See Hinloopen and Soetevent, 'Laboratory Evidence' (n 52).

defections are made public. As we have explained, this ensures that the leniency policy is mainly used to discipline price defections, as it excludes the pro-competitive effects linked to the optimal 'deviate and report' strategies. Since excluding ringleaders allows only the deviator and one more firm to report, the punishment for non-ringleaders that deviate on price is reduced; when they report, they expect half of the fine reduction instead of one third. Before drawing any policy conclusions from these results, it is therefore important to wait for more realistic studies that allow subjects to apply for leniency when deviating on prices and be re-matched to play several supergames and learn.

Davies and De empirically examined the frequency and characteristics of ringleaders in the EU and how they were treated when a leniency policy was introduced.[83] Ringleaders were identified in one-fifth of 78 EU cartels. They were often the largest cartel member(s) and formed agreements in markets with weak or no trade associations. The authors concluded that, although ringleaders were penalised more heavily after the introduction of the leniency policy, ringleader discrimination present in the 1996 EU leniency policy and removed from the 2002 version has not prevented the emergence of ringleaders.

More recently, Clemens and Rau studied the ringleader issue in a reduced form participation-revelation game in which ringleaders may or may not emerge.[84] They implemented a cartel formation game where the cartel is established in a multi-stage decision game preceded by a communication stage. If some cartel members chose to open a communication window that is not necessary for the cartel to be formed, these cartel members became the ringleaders. The experimental design did not include any form of market interaction, whether static or dynamic, nor pricing decisions. Subjects that chose to take part in a cartel were then always bound to the joint-profit-maximising strategy, while outside firms played best-response. They then implemented treatments without leniency, with leniency open to all, and with leniency only open to non-ringleaders. They found that excluding ringleaders from obtaining leniency reduced the number of reports, increased the number of cartels formed, and even increased the number of subjects becoming ringleaders. They concluded that excluding ringleaders from the leniency policy is likely to reduce its effectiveness.

These results are instructive, as they isolate the effect of ringleader exclusion on reporting, from their interaction with market strategies. However, in terms of evaluating the effectiveness of a leniency policy, they suffer from a similar limitation as the study by Hamaguchi, Kawagoe and Shibata.[85] As previously discussed in relation to that paper,[86] it is difficult to interpret the results of an experimental design that does not include any form of market interaction and to translate them into policy prescriptions. Clemens and Rau took the view that not including a market game was 'necessary as defection from the cartel price by a shirking firm might influence the decision to form a cartel as much as the possibility to opt for leniency'.[87] Indeed, we know from the previously described experiments that market behaviour and reporting behaviour interact in important ways. From a policy point of view, however, we are interested in these interactions, as it is cartel formation and prices that determine changes in welfare,

---

[83] See S Davies and O De, 'Ringleaders in Larger Number Asymmetric Cartels' (2013) 123 *Economic Journal* F524.

[84] See G Clemens and HA Rau, 'Do Leniency Policies Facilitate Collusion? Experimental Evidence' (2014) http://papers.ssrn.com/sol3/papers.cfm?abstract_id=2343915.

[85] See Hamaguchi, Kawagoe and Shibata (n 56).

[86] See n 56 and accompanying text.

[87] Clemens and Rau (n 84) 2.

not the number of reports (which in themselves typically lower welfare by increasing prosecution costs). If we exclude market interactions from the design, it becomes difficult to understand if and how the measured reporting behaviour would change in the presence of market interactions, and how market outcomes and welfare are likely to be affected by leniency.

To conclude, taken together, these available experimental results suggest that ringleaders should be allowed to apply for and obtain leniency. However, given the caveats in all these studies, further research appears necessary to investigate the robustness of this conclusion.

ii Leniency and Auctions

Hamaguchi and others studied collusion in a repeated procurement auction game and the effectiveness of leniency policies in that environment.[88] They considered cartel creation at first-price sealed-bid auctions and allowed for unrestricted communication before bidding. The experiment allowed for five competitors and the formation of partial cartels. In addition, the competition authority could detect individual cartel members (but not the entire cartel) and the fine imposed was a share of the individual's gross earnings in the last three periods. No communication was allowed before the bid in the 'benchmark' treatment, whereas in 'communication', a three-minute chat where subjects decided whether or not to enter the chat room preceded the possible bid. In 'antitrust', communication was allowed and there was a 15 per cent probability of detection by a competition authority. In 'communication', virtually all bids were set at the monopoly price, so bidders clearly colluded and did not cheat on the agreement reached in this phase. Leniency policies turned out to be ineffective in decreasing the number of cartels in the auctions, and the average winning bid did not change. However, there was some evidence that leniency policies may be effective to dissolve pre-existing collusion and decrease the contract price. In 'antitrust', most of the pre-collusive groups bid their reserve price and were then dissolved by defectors before the end of the experiment.

Hinloopen and Onderstal studied cartel formation and leniency policies at first-price sealed-bid and English auctions.[89] In their experiment, each subject started by choosing between 'yes' or 'no' buttons that indicated their willingness to join a possible cartel. They were then told whether a cartel formed, but not about individual votes. If a cartel was established, a winner was randomly assigned by the computer and was the only subject who could submit a bid. The highest bidder won the object. In subsequent rounds, subjects needed to bid higher than the winning bid, and the rounds ended when no subject bids or when one bids the maximum possible bid. There was no competition authority in 'agreement', but the 'detect and punish' and 'leniency' treatments entailed a 15 per cent chance of detection and prosecution. In the latter, firms could also report the cartel once the auction ended for a small cost, and they did so ignorant of the other player's reporting decision. Hamaguchi and others' result on the ineffectiveness of the leniency policy in first-price sealed-bid auctions was corroborated.[90] Nonetheless, in

---

[88] See Y Hamaguchi and others, 'An Experimental Study of Procurement Auctions with Leniency Programs' (2007) CPRC Discussion Paper Series CPDP-24-E January 2007, www.jftc.go.jp/cprc/discussionpapers/h18/index.files/CPDP-24-E.pdf.

[89] See J Hinloopen and S Onderstal, 'Going Once, Going Twice, Reported!' (2013) Tinbergen Institute Discussion Paper TI 2009-085/1, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1486043&download=yes.

[90] See Hamaguchi and others (n 88).

English auctions, a traditional antitrust policy (with no leniency policy) seems able to deter and destabilise cartels, but it also has the negative effect of reducing the average winning bid (that is, the price). Although the introduction of a leniency policy seems to have had no impact on cartel formation or recidivism, it did have two undesirable effects: it increased cartel stability and reduced the winning cartel bid, in line with the results in the study by Bigoni and others.[91]

iii Leniency after Prosecution Has Started and Avoidance Activities

All the experimental work discussed to this point in the chapter does not specify whether or not an investigation of the cartel had been started at the time a leniency application is made. The assumed positive probability of exogenous detection can be interpreted both as the probability of a successful investigation and as the probability that an existing investigation, started with the formation of the cartel, will be successful. The presence of robust deterrence effects in many of these experiments demonstrates that the assumption on which early studies of leniency policies are based — that programs restricted only to spontaneous reports before an investigation is open cannot be effective — is incorrect both logically and empirically. These experiments cannot tell us, however, how opening leniency policies to reports coming after an investigation is opened or announced will affect deterrence and welfare.

This question was the focus of a study by Dijkstra, Haan and Schoonbeek, in which firms could apply for leniency once an antitrust investigation had been announced and could also communicate freely.[92] In the common setting of a repeated and homogeneous Bertrand duopoly, if firms chose to communicate and set prices, an investigation may (or not) be opened. Subjects could apply for leniency once they learned about this, thereby ensuring conviction. Otherwise, conviction occurred with some probability. If convicted, a fixed fine was paid. The experiment showed that individuals are able to fix and keep prices high by agreeing on prices and reporting and by agreeing on future communication strategies. Some evidence of desistance and destabilisation effects, due to the leniency policy, was found in the very short-term, but these disappeared over time.

Finally, an interesting recent experiment by Chowdhury and Wandschneider looked at the effect of leniency policies when firms can invest in costly avoidance activities,[93] an important and under-researched topic in competition law. They augmented the stage game from their earlier work[94] with the possibility, in some treatments, of cartel members undertaking a costly investment that would permanently reduce the (absolute) fine they would face in future periods if convicted. The authors found that avoidance activities increase cartel formation (by risk-averse subjects) and that firms which invest in avoidance charge higher prices. They also found that such firms deviate and self-report more often when a leniency policy exists. This indicates that in the presence of a leniency policy, some firms use avoidance to reduce their punishment for price deviations. This is what should be expected in a set-up similar to that of Hinloopen and Soetevent,[95] where firms can only self-report after prices

---

[91] See Bigoni and others, 'Fines, Leniency, and Rewards in Antitrust' (n 64).

[92] See PT Dijkstra, MA Haan and L Schoonbeek, 'Leniency Programs and the Design of Antitrust: Experimental Evidence with Rich Communication' (2014) www.rug.nl/staff/p.t.dijkstra/experiment_paper.pdf.

[93] See Chowdhury and Wandschneider (n75).

[94] See Chowdhury and Wandschneider, 'Anti-Trust and the "Beckerian Proposition"' (n 73).

[95] See Hinloopen and Soetevent, 'Laboratory Evidence' (n 52).

(deviations) become known. In such a set-up, the leniency policy mostly acts as a punishment device. Understanding how there results would change in a more realistic set-up, where firms can also report before their price deviations become common knowledge, appears to be an exciting avenue for further research.

IV Conclusions

There is no doubt about the increasing importance of leniency policies for competition authorities' daily enforcement work. So much is reflected in the growing number of firms applying for leniency reductions in exchange for information and co-operation. However, it is important to ensure that leniency policies are well-designed and properly administered if they are to be effective at deterring cartels, rather than merely making it easier for competition authorities to detect and prosecute cartels.

A poorly designed or too generously administered leniency scheme provides an easy way for cartelists to escape or reduce fines and may therefore encourage cartels that would not otherwise form. A generous leniency policy combined with mild sanctions is likely to maintain or increase the deadweight losses from administration, prosecution and litigation costs, with no balancing benefits for the taxpayer. Evaluating how these policies are implemented in reality, and how their design and management could be improved, is therefore crucial.

Existing empirical studies provide mixed results. Our conclusion from reviewing the empirical work is that much more empirical work is needed. Judging from the very limited empirical evidence available, it is still not well-established whether leniency policies, as currently designed and implemented in different countries, are doing any more than facilitating competition authorities' work. That is, it is unclear whether they are actually increasing welfare by generating a strong deterrence effect, or whether they are actually reducing welfare through the larger administration and prosecution costs they generate, without any compensating increase in deterrence. The most favourable evidence available is for the US, where sanctions are much tougher, and this is consistent with what theory would predict. But the evidence is in general rather weak.

An increasing number of experimental studies clearly demonstrate that the assumption on which some early economic analyses were based — that leniency policies can only be effective if it is open to firms under investigation to report — is not only ad hoc and unjustified, but also empirically counterfactual. Although this is not to say that, given constraints on sanctions and rewards, it is not optimal to open leniency policies to reports after an investigation.[96] The bulk of experiments also suggest, consistent with the available empirical evidence, that cartel deterrence effects of well-designed and well-administered leniency policies tend to be positive — whether or not the policy is open to reports after an investigation opened — but rather modest unless sanctions for non-applicants are really severe or monetary rewards are introduced. Most recent experiments suggest that severe sanctions are the crucial precondition for the effectiveness of a leniency policy, allowing it to produce substantial cartel deterrence effects even when the probability of a cartel being detected without reports is zero.

Experiments also show that subjects quickly understand how to game these schemes, if they can be gamed, so that poorly designed and loosely administered real world leniency policies are likely to reduce social welfare considerably. For example, there is robust evidence that a leniency policy may be used to punish deviations, making cartels more stable. Some experiments tend to have rather loose connections with both

---

[96] See Z Chen and P Rey, 'On the Design of Leniency Programs' (2013) 56 *Journal of Law and Economics* 917.

the theory and the practice of leniency policies, making it hard to use their results as guidance for policy-making. Future experimental work should pay more attention to both theory and reality. Several open questions are waiting for more careful examination, starting with the introduction of fines or damage payments which are a function of accumulated cartel profits.[97]

The lack of stronger evidence — whether in favour or against the hypothesis that leniency policies are increasing cartel deterrence and with it social welfare — is undoubtedly linked to the difficulty of identifying how the total population of cartels changes when leniency policies are introduced or modified. But it is also clearly linked to an endemic lack of data. It seems crucial that competition authorities or agencies in charge of supervising them start to implement more consistent data collection and data disclosure policies. Such policies would facilitate more meaningful empirical research in this important field.

---

[97] As in JE Harrington Jr, 'Cartel Pricing Dynamics in the Presence of an Antitrust Authority' (2004) 35 *RAND Journal of Economics* 651.

Tables:

	EU 1998–2011 (Marvão, 'The EU Leniency Programme and Recidivism' (n 19))		US 1996–3/2010 (JM Connor and DJ **Miller**, 'Determinants of U.S. Antitrust Fines of Corporate Participants of Global Cartels' (**2013**))		Asia 1990–2007 (Connor, 'Focus on Asia' (n 10))		Russia 2004–11 (**Yusopova (n 38)**)	
	Aver.	*Max.*	*Aver.*	*Max.*	*Aver.*	*Max.*	*Aver.*	*Max.*
Number of cartels	-	95	-	39	-	33	-	30
Number of cartels with leniency policy applications	-	81 (in analysis)	-	30	-	-	-	9
Number of self-reported cartels	-	55	-	30	-	-	-	-
Number of firms per cartel	8.3	17	9.7	25	-	-	11	51
Total number of multiple offenders	-	63/385	-	-	-	-	-	-
Total number of repeat offenders (sequential cartels)	-	6/385	-	-	-	-	-	-
Number of leniency reductions granted per year	20	67	7.1	-	-	-	-	-
Amount of leniency reductions granted per firm (%)	24	100	-	-	-	-	-	-
Fine increase per firm (%)	23.6	290	-	-	-	-	-	-
Fine reduction per firm (%)	2.7	100	-	-	-	-	-	-
Prison time per firm (number of months)	N/A	N/A	3.7	99	-	-	-	-
Penalties paid per firm (US$m)	49.99	800.99	42.4	400	21.51	146.3	3.08	28.58
Cartel overcharge per firm (US$m)	0	0	1,591	10,290	-	-	-	-
Cartel duration (months), according to courts	97.8	419	85.6	365	44.4	-	18.3	96
Duration of cartel investigation (months)	46.9	96	-	-	-	-	-	-

Table 1: Recent statistics on cartel cases

	Region	Time frame	N (cartels)	N(firms)
J-R Borrell and JL Jiménez, 'The Drivers of Antitrust Effectiveness' (2008) 185 *Hacienda Pública Española* 69	World	2003–04	7	N/A
Miller (n 23)	US	1985–2005	342	N/A
JM Connor and DJ Miller, 'Determinants of U.S. Antitrust Fines of Corporate Participants of Global Cartels' (2013)	US	1996–3/2010	39	124–30 (1st reporters)
Arlman (n 43)	EU	1990–2004	67	N/A
Brenner (n 25)	EU	1990–2003	61	232
Klein (n 37)	EU	1990–2010	23 countries	3164

Marvão, 'The EU Leniency Programme and Recidivism' (n 19)	EU	1998–10/2011	81	385
Zhou (n 35)	EU	12/1985–2011	126	N/A
Gärtner and Zhou (n 44)	EU	1996–2012	96	105 applicants
JM Connor and DJ Miller, 'Determinants of EC Antitrust Fines for Members of Global Cartels' (2013)	EU	1990–early 2010	43	207 (3 excluded)
Marvão, 'Heterogeneous Penalties' (n 46)	EU US	1998–10/2011 1984–2009	81 799	385 2013
Yusupova (n 38)	Russia	2004–11	30	329

Table 2: Datasets used in econometric studies