

# The EU Leniency Programme and the Factors Affecting Fine Reductions

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## ABSTRACT

The primary aim of the Leniency Programme (LP) is to provide incentives for the deterrence and dissolution of cartels. Its growing importance and usage make it essential to investigate the effects of the programme, not just in terms of the absolute number of cartels discovered but in terms of its effects and, ultimately, its efficiency. The EC guidelines highlight the importance of the reporting of a previously unknown of the cartel and provision of significant added value to an existing investigation, but the exact nature of the rewards for such information in terms of fine reductions are somewhat vague. We present empirical evidence that the first cartel member reporting the cartel can expect very significant fine reductions, especially if the firm has previously been found to collude and if the firm reports it before an investigation by the European Commission is initiated. While the duration of the cartel, and the damage associated with the cartel, seem irrelevant in terms of percentage fine reduction, the sector of damage significantly affects the amount of reduction as does the location of the final customers.

JEL Classification: K21, K42, L4, L51

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## 1. Introduction

Recent antitrust cases provide evidence that cartel agreements are a perennial problem in the EU. Since the beginning of the year<sup>1</sup>, 6 groups of firms have been put under formal cartel investigation by the European Commission DG-Competition<sup>2</sup>, whose top priority has become to dissolve and deter cartels. *Article 101*<sup>3</sup> of the Treaty explicitly prohibits the existence of cartels, which is an issue not only relevant to antitrust policy, but to society more generally. The social costs of these illegal activities are noticeably large, whether the cartel concerns price-fixing, fixing sales conditions or exchanging customer information, which are the most common forms of cartel behavior. Following the example of the "successful" US Leniency Programme, initiated in 1978, the European Commission launched, in July of 1996, the European Leniency Programme (*LP*). This programme was then revised in 2002 and 2006, becoming more detailed and more "generous". The LP consists in granting immunity or reduction of fines to individual firms that are members of a cartel, in exchange for the initial reporting of the cartel and/ or relevant cooperation with the EC.

The present paper attempts to address the following question: What can a firm expect when reporting to the EC, in terms of percentage fine reduction due to the LP? This is, which firm or cartel characteristics will influence the leniency decision of the EC? Ideally, the expectations by firms are such that the programme prevents future cartels and creates a destabilizing effect for existing cartels. According to the latest LP (2006), a firm can obtain a reduction if it provides "*evidence of the alleged infringement which represents significant added value with respect to the evidence already in the Commission's possession*"<sup>4</sup>. Since each cartel member has privileged information on the other

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<sup>1</sup>Data is updated up to April 9th, 2010.

<sup>2</sup>Cartel members can report either to the national antitrust authority or directly to the EC. The cases will then be dealt by the EC (DG-Competition) if they have an appreciable effect on interstate trade or by the national antitrust authority if they are national cases. We only deal with the international cartel cases, in this paper.

<sup>3</sup>Article 101 of the Treaty on the Functioning of the European Union, formerly Article 81 of the EC Treaty.

<sup>4</sup>Among other guidance, which can be found in the LP Guidelines

wrongdoers, this programme provides an incentive to report such information. It seems to be, at least theoretically, a socially desirable programme: the reporting cartel member does what it is in its best interest and receives a partial or total fine reduction, while increasing the probability that cartels are detected and thus, decreasing the prosecution costs incurred by the EC and the damages ultimately suffered by customers and final consumers.

There is a voluminous theoretical literature on collusive pricing and cartel behavior which also attempts to take into consideration a LP. Bloom (2006) and Wils (2007) both evaluate the EU LP, using the word "successful", while doubts on its efficiency are raised by Chang and Harrington (2009a), Houba et al.(2009) and Harrington (2008). This is mainly because it is difficult to evaluate the total number of existing cartels besides the ones that were discovered.

The associated game theoretical literature is ambiguous regarding the impacts of a LP. It is generally agreed that, in equilibrium, the programme may create a prisoner's dilemma amongst cartel members in a static context that drives the offender to confess and the cartel to be dismantled (Herre (2009), Chen and Rey (2007) and Spagnolo (2004)). However, the effects on deterrence are in reality uncertain: Aubert et al.(2006) and Buccirosi and Spagnolo(2006) find that the LP effectively increases deterrence, but Chang and Harrington (2009b) find the opposite effect, while Bigoni (2009) and Spagnolo (2004) find that the effect depends on specific circumstances.

The ambiguous conclusions in the above referred literature suggest the need for different approaches. Recently, Levenstein and Suslow (2009) carried out an empirical study to establish the determinants of cartel duration. The authors use a model of proportional hazard on 654 cartel-year pairs during which a cartel is colluding and is at risk of breakup, concluding that the main cause of cartel "death" is active enforcement by the EC. Miller (2009) finds that the number of cartels discovered increases in the periods around the introduction of the LP and decreases to pre-LP levels afterwards.

The empirical work that mostly relates to our paper is by Brenner (2009), using data for 61 cartels that make use of the LP, between 1990 and 2003. The author

uses an OLS regression to find the impact of the LP, cartel duration, number of countries damaged by the cartel and number of firms in the cartel, on the total and reduced cartel fines and on the duration of the investigation. The only significant result in the paper shows that the LP increases both total and reduced fines and decreases the investigation duration.

We contribute to the current literature by looking at which factors influence the setting of leniency reductions granted to each individual firm in a cartel. This is not only innovative in the research question but also in the use of firm-level data and in the elimination of sample selection bias.

In our analysis we use empirical data to find the impact of firm and cartel level characteristics on percentage fine reduction individually obtained by each of the confessing cartel member. Using a Heckman two-stage model, we find that being the first to report is particularly advantageous for a firm as it decreases its fine by around 70 percentage points. However, and perhaps surprisingly, firms that have participated in several cartels obtain reductions nearly 14 percentage points higher than the reductions of single offenders. In addition, the number of repeat offenders in a cartel appears to lead to further reductions. Finally, we find that cartels that exclusively affect EEA consumers receive higher fine reductions. This is a novel strand of literature, since empirical analysis on cartels usually carries issues of sample selection bias, unobservable variables and misleading inferences. We overcome these problems using the Heckman two-stage model and the complete population of cartels that availed of the LP.

The organization of the paper is as follows. In the next section we briefly explain the policy background. In section 3, we describe the data set. The methodology is described in section 4 before we present the empirical results in section 5. Section 6 concludes.

## **2. Policy Background: Fines and Leniency**

To enforce Article 101 of the Treaty on the Functioning of the European Union, the Commission issues non statutory documents under the form of

notices and guidelines, which serve to explain the procedural issues that govern cartel's detection and penalization.

The current guidelines on the setting of general fines for cartels were released in 2006<sup>5</sup>. According to them, the fines are set according to the following formula:

$$Fine(t) = [sales\ value(t-1)] * [a\% * cartel\ duration + b\% + aggravating\ c. - mitigating\ c.],$$

where  $t$  represents the time period,  $a \leq 30\%$ , depending on the degree of gravity of the infringement and  $b \in [15\%, 25\%]$ , aiming at deterring undertakings from entering horizontal price-fixing, market-sharing and output limitation agreements. The fines are also adjusted according to the so-called aggravating and mitigating circumstances<sup>6</sup> and the final value can not exceed 10% of the turnover of the firm in the previous year. Finally, special conditions are set in the case of inability to pay.

The Leniency Programme adds to these guidelines, having updated its version of 1996, in 2002 and 2006. It applies to secret cartels between at least two competitors. The 2002 guidelines are much more detailed than those of 1996 and provide higher reductions for the reporting firms. The major changes in the LP of 2006 are in terms of clarification and additional flexibility to the previous Notice, regarding the immunity thresholds and the conditions for fine reductions, as well as the introduction of a discretionary marker system<sup>7</sup>. The bands for the percentage fine reductions are set as stated on *Table 1*.

[Table 1 here]

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<sup>5</sup>Guidelines on the method of setting fines imposed pursuant to Article 23(2)(a) of Regulation No 1/2003, 2006/C, 210/02

<sup>6</sup>Aggravating circumstances apply in the cases of recidivism, absence of cooperation or obstruction to the investigation or role of cartel leader or instigator. Mitigating circumstances relate to termination of the infringement at the time of the investigation, negligence as the cause of the cartel, limited involvement in the cartel, cooperation with the Commission outside the LP and proof of having been encouraged by public authorities or legislation.

<sup>7</sup>For further information on these please refer to the Guidelines, available at: [http : //ec.europa.eu/competition/cartels/legislation/leniency\\_legislation.html](http://ec.europa.eu/competition/cartels/legislation/leniency_legislation.html)

The procedures are fairly simple: the firm representant can contact the EC to verify if there is already an investigation in its market and if there is already a leniency application. The firm can then decide whether or not to report and/or cooperate. In case it decides to cooperate, it will qualify for a fine reduction under the LP if, besides additional behavioral conditions, it provides "significant added value with respect to the evidence already in the Commission's possession". This is rather vague, since the applicant does not know, when applying, what information the EC has and to which extent can it meet the "added value" requirement. The rest of this paper attempts to clarify this issue by reviewing the actual application of the LP and revealing the major determinants of the percentage reduction in fine.

### **3. Data**

#### *3.1. Data collection*

The data employed in the empirical analysis was compiled using the publicly available information on the antitrust cases handled by the European Commission and accessible via the EC's website. For each of the cartel cases, only those in which the LP was applied were selected. All the information was obtained from associated press releases and summary reports. The final decisions on the setting of fines, for the cases in analysis, were taken between 1998 and 2009 and include the universe of cases making use of the LP, updated on April 9th 2010. The starting date of the investigation for these cases range between 1994 and 2007. The investigation year is the official date at which the Commission started the investigation, and hence not necessarily the one in which the cartel was reported. There are 57 cartel cases, which involve 297 firms, resulting in a total of 370 firm-level observations. This discrepancy is due to the existence of several firms that took part in more than one cartel and are therefore, labeled repeat offenders.

For each case, information was gathered at the case level, regarding the duration of both the cartel and the investigation carried out by the Commission,

the number of firms in the cartel, the geographic area in which the cartel impacted, the LP in use (1996, 2002 or 2006), the type of cartel infringement<sup>8</sup> and the years of reporting of the cartel to the EC, initiation of the investigation and of final decision. Firm-level information was also collected and includes the individual fine both before and after the leniency reduction<sup>9</sup> and other reductions obtained by each firm, outside the LP. These result from mitigating circumstances, such as not disputing the facts and acting under instructions of another firm. Additional information was compiled for whether the firm was, in April 2010, a repeat or single offender.

### 3.2. Data description

The number of cartels discovered since 1998 has been increasing, as well as has been the total number of firms involved in cartels, in each year. This is shown in *Table 2*, which shows the number of cartel cases closed, the number of firms fined in each year and the number of reductions under the LP, for the period between 1998 and 2009. It is important to bear in mind that the figures presented for the number of cases using the LP may differ from the actual values, due to the cases under investigation (open) and for which, public information is not yet available. This is specially true for the years of 2007 and 2009, where 5 and 16 cases, respectively, are still being examined. Additionally, the number of open cases for the year of 2010 is also included. The figures for "cases still open" correspond to the latest update on a case, i.e. the year in which a given case had its last development and it is still open in 2010. The number of cartel cases is also divided into those found due to the LP, this is, when one of the cartel members reports the existence of the cartel to the competition author-

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<sup>8</sup>The types of cartel infringement incurred in the cases in analysis are mainly price fixing but also include allocation of tenders, fixation of quotas and sales conditions, sharing of geographic market, exchange of sensitive information on prices, sales volumes and procurement tenders, elimination of price discounts and bid rigging.

<sup>9</sup>It may be of some interest to look at the highest fines imposed on a cartel member, after the leniency reduction. *Saint-Gobain SA* was fined 896 million euros, after having received 50% of a leniency reduction, in 2009 for its participation in a carglass cartel. *F.Hoffmann-La Roche AG* received, in 2001, a fine of 462 million euros (with 50% leniency), for being a member of a vitamins cartel. Siemens, Germany paid a fine of over 396 million euros for collaboration in a cartel for gas insulated switchgear, in 2007.

ity, before any investigation had started, and the cases that were discovered for other reasons, such as reporting by a third party as a consumer or a rival firm, or by the Commission's own initiative, perhaps by observing the evolution of prices.

An increasing number of firms has been making use of the Leniency Programme. Looking at the spontaneous applications, it occurred five times, both for 2008 and 2009, where the EC only found one other cartel by alternative ways, for each of these two years. The programme is becoming increasingly important, both in terms of the reductions given and the number of cases making use of it, before the Commission started any procedures.

[Table 2 here]

The allocation of the percentage of leniency reductions given is shown on *Figures 1 and 2*, where the "generosity" and willingness to provide incentives to self-reporting have visibly increased. Over 25% of the reductions correspond to immunity, for the period of 2006 to 2009, while this corresponded to a very small share in 1998 to 2001. Conversely, reductions below 10% became very scarce. *Table 3* reports the distribution of reductions given between 1998 and 2009. Over half (55%) of all the cartel members in which the LP was used and for the period of 1998 to 2009, received a reduction in the fine, and just over 10% received total immunity. These large numbers show the importance of the programme and of the need to understand the main factors impacting on the setting of the percentage fine reductions.

[Table 3 here]

[Figure 1 here]

[Figure 2 here]

A major concern when studying the evolution and behavior of cartels is the continuous offenses by the same firm. *Table 4* shows the distribution of

the firms fined according to the number of cartels in which they have taken part. These numbers may even be underestimated since we have no information regarding cartels that have not been discovered. It is noticeable that most of the firms (nearly 80%) have only been found to participate in one cartel, but firms like *Bayer AG* and *Evonik* have been members in a total of five cartels, in the past eleven years. These firms have received reductions under the LP in all five cartels and immunity in three and two of them, respectively. Apparently even more serious is the case of *Akzo Nobel*, which has been in nine cartels and received immunity from fines three times, as well as substantial reductions in another four cartel cases.

[Table 4 here]

## 4. Methodology

### 4.1. Choice of variables

*Table 5* defines the variables in use in the model specifications. To explain the leniency reduction given to a single cartel member, in percentage terms, firm-level and case-level variables were chosen. Dummies for the first firm to give information on a cartel, both before and after the investigation started, and a dummy on to whether or not the firm is a repeat offender are included. Also, the number of repeat offenders per cartel, a dummy that accounts for exclusively intra-EEA based final consumers and the duration of the official investigation are included.

The longer an investigation lasts, the more likely it is that more firms apply for the LP and the more information will, in principle, be revealed, leading to higher fine reductions due to cooperation. However, it is possible that this effect turns around after a given point in time, since more information revealed means more details on the infringements and more accurate predictions of the extent and scale of damages caused to consumers, so this might reduce the leniency reduction. This quadratic relationship is tested squaring the variable for investigation duration.

[Table 5 here]

#### 4.2. Regression method

The main goal of this paper is to find which features of firms or cartels drive the percentage of leniency reduction given to each individual leniency applicant. Two main criteria influenced the choice of this specific method. Firstly, the collected data regards all cartel cases making use of the LP, but we have no information on the rest of the cartels that were discovered and in which the LP was not used, or on the cartels that have not been discovered, so there might exist a problem of non-randomly selected samples. Secondly, there are two levels of decision in the model: whether a cartel member receives a leniency reduction or not <sup>10</sup> and the amount of reduction granted. However, it is clear that fixed effects at the firm level are necessary to control for firms that are members in distinct cartels. Models like tobit and logit jointly model the factors affecting the decision of granting a fine and the amount given, so they may not be appropriate in this analysis. For these reasons, the Heckman's (1979) two-stage model is used, allowing two stages of decisions and hence correcting for a possible selection bias.

The first stage of Heckman's approach is a participation model, which estimates the probability that a firm receives a leniency reduction. The canonical specification for this relationship is a binary probit of the following form:

$$\text{Prob}(lred0 = 1|X) = CDF(X\gamma), \text{ and}$$
$$X = [lp1_j \ lp2_j \ EC1_{ij} \ inv1_{ij} \ ro_{ij} \ ro1_{ij} \ roi1_{ij} \ nr_j \ eea_j \ y^*_t],$$

where  $lred0$  is a dummy variable that takes the value of 1 if the firm received a leniency reduction and 0 otherwise,  $X$  is the vector of explanatory variables,

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<sup>10</sup>This can be seen as being very closely related to whether or not the firm applied for a reduction, since both variables match for the great majority of the cases

$\gamma$  is a vector of unknown parameters and  $CDF$  is the cumulative distribution function of the standard normal distribution.

In the second stage, a behavioral model makes use of the correction of a possible self-selection problem. It uses the individual probabilities predicted in the first stage to calculate the inverse mills ratio ( $imr$ ), which becomes an additional explanatory variable. The dummies that control for the very own LP are excluded in this stage, since they are more likely to influence the decision to grant the fine reduction than its actual amount. This identification restriction, which requires the exclusion of at least one independent variable from the second stage, is imposed by this method. The specification chosen is a fixed-effects model:

$$lred_{ijt} = EC1_{ij} + inv1_{ij} + ro_{ij} + rol_{ij} + roi1_{ij} + idur_j + idur_j^2 + nr_j + eea_{ij} + imr + y*_t + \varepsilon_{ij},$$

where  $i$  and  $j$  are the indexes for firm and case, respectively, and  $\varepsilon$  is the error term, which is assumed to be *iid*. The variable  $imr$  is estimated through the quotient between the probability density function and the cumulative density function. The t-value for the  $imr$  allows us to test whether it is or not statistically different from zero. If it is not, then the sample selection bias is not a cause for concern in the data and OLS coefficients are reliable. The results of the estimations are presented in the next section.

## 5. Results

The results of the specifications shown above are reported on *Table 6*, where three different versions of the basic model are tested.<sup>11</sup>

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<sup>11</sup>The covariance matrix generated by the FE estimation of the second stage is inconsistent. For this reason, we omit the values for the standard errors but these can be generated from an asymptotic approximation or by resampling. Furthermore, to ensure consistent and robust estimators, the errors of the probit model were tested and found to be jointly normal.

[Table 6 here]

The dummy variables accounting for the first cartel member reporting the cartel to the EC, either before (*EC1*) or after (*inv1*) the investigation had started present coefficients of approximately .7 to .8. This means that a firm that succeeds in being the first to report to the EC may expect its reduction to be increased by around 75 percentage points. Since this analysis includes the three LPs, this number is probably higher if we exclude the LP of 1996, since the LP has become more "generous" for the first reporter. This finding goes in line with the LP Notice<sup>12</sup>, stating that the most important factor for a very high reduction, is to be the first cartel member to report.

Observing the dummy for repeat offenders (*ro*), it is somewhat counter-intuitive that the fact that a firm has participated and been fined in previous cartels, is associated with the granting of a higher leniency reduction, this is, 13.5 percentage points higher than a firm that has not been found guilty for cartel participation before. Adding the fact that, for each firm which is a repeat offender, the reduction of the individual member is 4.7 percentage points higher, it possibly suggests some strategic behavior. A firm previously fined can learn "the rules of the game" and take advantage of the LP. This may explain why there are so many firms being caught, fined and posteriorly participating in other cartels. It is perhaps somewhat reassuring that if the firm is both a repeat offender and the first member to report the cartel, its fine reduction is only increased by less than 1 percentage point, if pre-investigation, and the reduction is actually decreased by around 37 percentual points, if post-investigation. The LP Notice<sup>13</sup> excludes firms that have a leading role from receiving immunity. However, it makes no statement regarding repeat offenders.<sup>14</sup>

One other interesting finding concerns the dummy for the EEA. Cartels, either with intra or extra-EEA firms but that damage exclusively EEA con-

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<sup>12</sup>It refers to the LP Notice of 2006.

<sup>13</sup>It refers to the LP Notice of 2006.

<sup>14</sup>It is important to notice that recidivism is accounted for in the aggravating circumstances in the setting of the original fine, as stated on section 2.

sumers, see their reporting firms receiving leniency reductions nearly 13 percentage points higher. Our findings might entail political reasons, since granting lower reductions within the LP to extra-EEA cartels (24% of the cases in our analysis) may be advantageous in the sense that it leaves a role for the foreign authorities to act and it decreases the impact of the LP abroad, where authorities may not view it as an appropriate programme. The LP Notice<sup>15</sup> only requires that firms indicate if "*other competition authorities, inside or outside the EU, have been approached or are intended to be approached*" but Brenner (2009) finds that if a higher number of countries are affected, fine reductions are augmented. Yet, this is not directly comparable and his result is not statistically significant and his variable for reduction appears to take into account leniency and other reductions.

Finally, the variables accounting for the duration of the investigation were not very significant in explaining the reduction granted. We expected that the longer an investigation lasts, the more firms can apply for the LP and be more collaborative with the EC, therefore being granted higher reductions. Yet, very long investigations were thought to imply that firms were denying the facts or providing less evidence than what would be desirable, therefore decreasing the leniency reductions given. The regression shows that this is not true and that longer investigations do, in fact, increase the reduction, but only by around 4 percentage points. Brenner's results show a decrease in the investigation duration with the use of the Leniency Programme, but he does not test for the impact on the reduction granted. We exclude these variables in specifications (2) and (3).

Initially, one other variable was constructed and included in the analysis. It accounted for the duration of the cartel. We thought it to be important, since Harrington (2006) argues that it may be informative as to the change in the total (discovered and not) number of cartels. Also, the Notice<sup>16</sup> stipulates

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<sup>15</sup>It refers to the LP Notice of 2006.

<sup>16</sup>It refers to the LP Notice of 2006.

that, if the first applicant cooperating, reports further information such that the EC establishes additional facts which increase the duration of the infringement, these will not be taken into account for that specific firm. Nevertheless, the coefficients for cartel duration were not statistically different from zero, so we dismissed it from our results.

Our results are robust and there is no sample selection bias, as demonstrated by the non-significance of the inverse-mills-ratio. We also include year fixed effects, which control for the three LP, and we include fixed effects at the firm-level, as mentioned earlier.

## 6. Conclusion

What does really matter to the setting of the percentage fine reductions within the Leniency Programme? Does it match the guidelines? Would firms use it in their own benefit?

There are no doubts as to the rising importance of the LP and the number of firms applying for reductions in exchange of information on secret cartels to which they belong to. It is thus of extreme importance to guarantee that the program works in an efficient way and it does not constitute an easy way to escape a fine. The best way of ensuring this is probably making the guidelines very clear and explicit, guaranteeing that firms clearly know the consequences they face and what they can expect. The vast game theoretical literature produces ambiguous results and the empirical literature is reduced to the papers of Brenner (2009) and Levenstein and Suslow (2006, 2009). We present empirical evidence on the way how leniency reductions are set, using a novel approach that eliminates the usual problem of sample selection bias and unobservable variables.

Our evidence suggests that, according to the LP Notice, the fact of being first reporter grants a high reduction around of, on average, 70 percentage points. Surprisingly, the values are similar for whether this occurs before or after the EC started an investigation. Firms that learn "how to play the game", repeatedly colluding, cheating on their cartel partners and reporting, seem to receive

reductions 16 percentage points higher and even 26 percentage points higher if they are the first to report pre-investigation. On the plus side, the reduction of the first post-investigation reporting firm is smaller if the firm has a past of collusion. If only EEA consumers are affected, fine reductions are increased by around 13 percentage points. The number of repeat offenders colluding and the duration of the investigation and of the cartel have an insignificant impact on the amount of reduction.

The existence and application of such a program has major impacts for the society in general and it seems that firms use it, to some extent, in their own benefit. From the point of view of a firm, it may seem better to enjoy higher profits of collusion, up to the moment of reporting to the EC, pay a small or no fine, since the reductions given are generally very high, and still enjoy the damage caused by the very high fines imposed on the other cartel members, i.e., the competing firms. From the point of view of policy-makers, the existence of firms that have participated in more than five cartels in the last ten years should come across as a warning sign that the LP is not working in the most efficient way. Finally, the guidelines should be more explicit and perhaps less generous, especially in what concerns repeat offenders.

## 7. Appendix

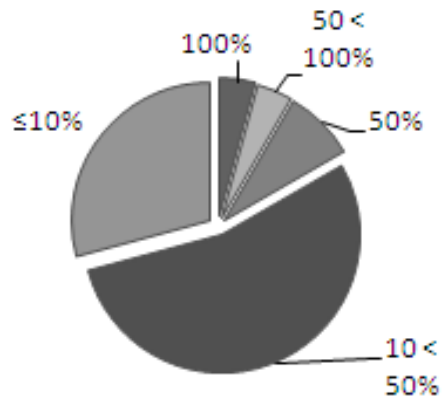


Figure 1: Leniency Reductions, 1998-2001

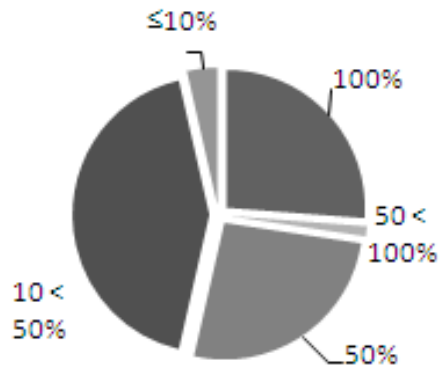


Figure 2: Leniency Reductions, 2006-2009

Table 1: Leniency reductions

	LP 1996	LP 2002 and 2006
1st reporter, before investigation	$\geq 75\%$	100%
1st reporter, after investigation	50-75%	30-50%
1st firm cooperating	10-50%	30-50%
2nd firm cooperating	10-50%	20-30%
subsequent firms cooperating	10-50%	$\leq 20\%$

Source: Author's interpretation of European Commission 1998, 2002, 2006

Table 2: Statistics on cartel cases, by decision year

Year	Closed and fined	Cases still open	No.firms (closed cases)	No. reductions (closed cases)	Closed cases found by LP
1998	2	-	11	10	0
1999	1	-	8	2	0
2000	2	-	13	5	1
2001	7	-	47	36	3
2002	8	-	44	33	5
2003	4	-	18	18	3
2004	4	3	15	9	4
2005	3	2	28	17	3
2006	5	2	66	15	5
2007	9	5	50	28	4
2008	6	3	45	11	5
2009	6	16	23	9	5
2010	0	6	na	na	na

Source: Author's calculations, using data from EC's website.

Table 3: Frequency of Leniency reductions conceded in 1998-2009

Reduction	Frequency
0%	162
7%	1
10%	30
15%	9
16%	1
20%	17
25%	18
30%	20
33%	1
35%	13
40%	21
46%	1
50%	27
61%	1
70%	1
90%	1
100%	37
total	361

Source: Author's calculations, using data from EC's website.

Table 4: Number of cartels per firm, 1998-2009

Number of cartels	Number of firms
1	241
2	45
3	11
4	3
5	2
6	0
7	0
8	0
9	1
sum	303

Source: Author's calculations, using data from EC's website.

Table 5: Definition of the variables

variable	definition
	DEPENDENT VARIABLES:
<i>lred0</i>	dummy (=1) if the firm received a leniency reduction
<i>lred</i>	percentage of leniency reduction given to a single firm $= \frac{\text{leniency reduction}}{\text{total fine} - \text{other reductions}}$ , in euro values
	INDEPENDENT VARIABLES:
<i>EC1</i>	dummy (=1) if the firm was the first to report the cartel to the EC
<i>inv1</i>	dummy (=1) if the firm was the first to give significant information after the cartel was discovered
<i>ro</i>	dummy (=1) if the firm participated in more than one cartel
<i>nr</i>	number of firms which are repeat offenders, in the cartel, $\epsilon[0, 8]$
<i>eea</i>	dummy (=1) if the cartel only affects the EEA market
<i>id</i>	duration, in years, of the investigation $\epsilon[2, 8]$
<i>id2</i>	squared investigation duration
<i>ro1</i>	interaction effect between "ro" and "EC1"
<i>roi1</i>	interaction effect between "ro" and "inv1"
<i>y*</i>	year fixed effects
	EXCLUDED VARIABLES:
<i>cd</i>	duration, in months, of the cartel $\epsilon[5, 347]$
<i>nf</i>	number of firms in the cartel $\epsilon[2, 17]$

Table 6: Heckman two-stage Results

(lred)	(1)	(2)	(3)
EC1	0.696	0.694	0.783
inv1	0.797	0.750	0.770
ro	0.159	0.117	0.135
ro1	0.100	0.087	
roi1	-0.386	-0.355	-0.370
nr	0.063	0.046	0.047
eea	0.139	0.124	0.125
id	0.040		
id2	0.000		
imr	0.063	0.035	0.041
constant	-0.182	-0.214	-0.235
year effects	yes	yes	yes
imr sign.	75.17%	73.89%	73.85%
R2 with.	65.50%	80.20%	76.00%
N	370	370	370
groups	285	285	285

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