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Leniency Policies and Cartel Success: An Experiment

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Abstract

Cartels are often fought by granting leniency, in the form of forgiveness of penalties, to whistle-blowers. This study employs a laboratory experiment to compare leniency programs that differ with respect to fine size and whether a second whistle-blower may apply for leniency. The results show that leniency does not affect the probability that a cartel forms, but is effective in exposing cartels and thereby inhibiting cartel success. Higher fines are more effective, but allowing leniency to a second whistle-blower is no more effective than granting leniency to only one whistle-blower.

Keywords: Antitrust, Cartel, Leniency policy, Experiment

1 Introduction

Economists and regulators have long been interested in the most effective policies to prevent the formation of cartels. While collusion and the formation of monopolies have generally been prohibited in the United States since the Sherman Antitrust Act of 1890, there have nevertheless been many attempts by companies to form cartels in a variety of industries. One reason that cartelization is an enduring problem is because once a cartel has formed, it can be difficult for antitrust authorities to expose it. Bryant and Eckard (1991) estimate the probability of catching a cartel at between 13% and 17% in the US.

Combe, Monnier, and Legal (2008) estimate the probability of uncovering a cartel in the EU at 12.9% to 13.3% in the period from 1969 and 2008. In addition, the costs of the investigations necessary to expose cartels can be substantial. For example, the US Department of Justice allocated $188.5 million for antitrust enforcement in 2021. The duration of investigations can also be quite long. For instance, in the EU, cases brought between 2000 and 2011 had an average length of investigation of 50.8 months (Hüschelrath, Laitenberger, and Smuda (2012)).

In order to make it easier to expose cartels, the US introduced a leniency program in 1978. This initial program allowed the first applicant for leniency to receive a partial exemption from the penalties and fines for collusion, including reduced criminal punishment. The hope was that by giving a partial exemption, whistle-blowing would be encouraged, leading to the breakup of existing cartels and the deterrence of future cartelization. The incentives were strengthened in 1993, with whistle-blowers receiving full immunity from any penalties. As a result, leniency applications have increased by a factor of 10, with convictions and fines skyrocketing as well.[1]

Following the success of the US policy, leniency policies were adopted by other countries. The European Union's leniency policy, instituted in 1996, guarantees the first whistle-blower a penalty exemption, but also grants fractionally reduced fines for second and third whistle blowers. South Korea introduced a leniency policy in 1997, and then in 2005 additionally guaranteed a partial penalty exemption of 50% for the second whistle-blower. Japan adopted a leniency program in 2006 that allows a partial fine exemption additionally for a third applicant. The magnitudes of the penalties for collusion differ by country. For example, the EU and South Korea impose a maximum penalty of 10% of revenue for firms that have acted as a cartel, while the US specifies a maximum penalty of 20% of "affected volume."

In this paper, using a controlled laboratory experiment, we study the effects of the two key components of leniency policies that vary internationally: the size of the penalty, and how many whistle blowers receive leniency. We consider whether, ceteris paribus, incentivizing a second whistle-blower with leniency and changing the fine size affect the rate of cartel formation, the probability of cartel exposure, the probability that an industry successfully colludes, industry profits, and the fines that the authorities collect.

The choice of experimental design and parameters was guided by a comparison of the American and South Korean leniency policies. Our research question is the following: is the system of leniency in the US more or less effective at reducing cartels than the system in place in South Korea? The policies differ in two dimensions. First, in the US, leniency is granted to one whistle-blower and in South Korea it is granted to two whistleblowers. Second, the fine size differs in the two countries, and is higher in the US than in South

[1] See https://www.justice.gov/atr/speech/detecting-and-deterring-cartel-activity-through-effective-leniency-program

Korea.[2] The two-factor, two-level design of the experiment considers which of the two dimensions might be the source of any differences in outcomes that we observe. An additional control treatment is used to establish whether some of the versions of the leniency policy might not even be better than no leniency policy at all.

Our data show that all of the leniency policies we include in our study reduce the ability of firms to successfully collude, with the exception of a policy granting leniency to two whistle blowers in conjunction with a relatively low fine. High penalties have the effect of reducing overall industry profits and increasing the fines collected by the state. The success of the leniency policies does not result from deterring the formation of cartels, but rather from increasing the rate at which they are reported and punished.

The paper is organized in the following manner. Section 2 discusses the prior experimental literature on cartel leniency. Section 3 describes the experimental design. Section 4 presents our hypotheses. Section 5 reports the results and Section 6 provides a summary of the results and a concluding discussion.

2 Previous related literature

Previous research has studied the effect of leniency policies on cartel activity and has verified that they do have an effect. Motta and Polo (2003) show that leniency increases the chance that a cartel is exposed, but also note that the cartel formation rate may actually increase due to the drop in the expected cost of cartelization. Leslie (2005) finds that allowing exemptions for cartel ringleaders may promote the destabilization of cartels. Miller (2009) verifies empirically that leniency programs lead to greater levels of cartel revelation and deterrence, using cartel data in the US from 1985 to 2005. However, Brenner (2009), using data from the EU during the period of 1990 to 2003, shows that it is possible for leniency policies to actually lead to cartel stabilization. Harrington Jr (2008) studies the effect of fine reductions and finds that a full fine exemption is more effective for catching cartels than a partial fine exemption, but the increase in the number of full fine-exempt firms may make it difficult to destabilize cartels. Zhou and Gärtner (2012) confirm that higher fine reductions give rise to the faster breaking-up of cartels.

A number of experiments have investigated the effect of leniency policies. See Marvão and Spagnolo (2014) for a survey. The initial studies considered environments with Bertrand price competition. Apesteguia, Dufwenberg, and Selten (2007) study the effect of leniency on cartel formation in a one-shot Bertrand game with homogeneous goods. There are four treatments in their experiment. In the *Ideal* treatment, no communication among firms is permitted and there is no opportunity for whistle-blowing. *Standard* allows communication among firms but there is no fine reduction from reporting a cartel. *Leniency* awards a fine reduction to firms that report their cartel. If

[2] In the US, the fine is 20% of "affected volume", which refers to revenue, and in South Korea it equals 10% of revenue. In December 2021, after this study was conducted, the fine size in Korea was increased to 20% of revenue, and is now comparable to that in the US.

only one firm reports, it is fully exempt from paying the fine (which is 10% of revenue). If there are $k > 1$ whistle-blowers, each receives a $1/k$ reduction in its fine. *Bonus* transfers the fine from those cartel members that are fined to whistle-blowers as a reward.[3] The results show that the *Leniency* treatment has the lowest rate of cartelization among the treatments, and also leads to lower prices than the *Standard* or *Bonus* conditions.

Hinloopen and Soetevent (2008b) consider behavior in a repeated Bertrand game, extending the setting of Apesteguia et al. (2007) to repeated interaction. Their design has four treatments. Under *Benchmark*, no communication is permitted. Under *Communication*, firms can communicate in every period. In *Antitrust*, a 15% probability of detection is introduced, and in *Leniency*, firms in the cartel can blow the whistle and obtain an exemption from their fine. There is a full fine exemption for the first applicant and a 50% fine reduction for the second applicant, as in two of our treatments. Hinloopen and Soetevent (2008b) find that *Leniency* reduces cartel formation and destabilizes existing cartels, but fails to reduce cartel recidivism from the level observed in *Antitrust*.

Bigoni, Fridolfsson, Le Coq, and Spagnolo (2012) compare leniency policies in a repeated Bertrand competition with two firms selling differentiated products. After deciding whether or not to communicate with the competitor, firms choose their prices. The treatments include a *L-Faire* condition, in which firms are free to collude, and a *Fine* treatment in which there is a probability of detection and penalty. In the *Leniency* treatment, if one firm reports the cartel, it receives full leniency, while if both report, each receives leniency equal to 50% of the fine. In the *Reward* treatment, if there is only one firm reporting, it receives a reward equal to the fine paid by the other firm. There are two chances to blow the whistle, both before and after setting prices. The authors find, as in the prior studies, that *Leniency* does reduce cartel incidence compared to the *Fine* treatment. *Fine*, in turn, leads to lower cartelization than *L-Faire*. Exempting the ringleader, defined as the first firm to start communication, from leniency, and well as increasing fines in the absence of leniency, have no additional deterrent power.

Bigoni, Fridolfsson, Le Coq, and Spagnolo (2015) study the effects of leniency, fine size, and detection probability. Their design allows some interaction effects to be studied that we cannot, such as the interaction between the fine size and the probability of detection and between leniency policy and the probability of detection. However, like the studies mentioned above, they use a Bertrand pricing paradigm, which is quite different from the Cournot setup that we employ. It differs both in underlying theoretical structure (the Bertrand game is one of strategic complements while the Cournot game is one of strategic substitutes), and in its propensity for collusive behavior (Bertrand competition leads to more collusion than Cournot competition). In Bigoni et al.'s design, there are two whistle-blowing opportunities, one before prices are set and one afterward. They find that both higher fines and leniency help deter

[3]While prior experiments show that awarding such rewards is effective in reducing the number of cartels, we rule out the study of reward systems here. The reason is that we are also interested in achieving high revenue from fines for the regulatory authority.

cartels, and fines tend to be more effective under leniency. They note that low fines can be counterproductive to the deterrence of cartels, since they may be used as punishments to stabilize rather than to deter cartels.

Chowdhury and Wandschneider (2018) study conditions with (i) a low cartel detection probability and high fine size, and (ii) a high detection probability and low fine size, each in a setting with and without leniency. Detection probability and fine size are not varied independently while holding the other variable constant. Their setup is also a repeated Bertrand setting with a random ending rule. They find that under leniency, there are fewer cartels under low detection rates and high penalties, but observe the reverse pattern in the absence of leniency.

Andres, Bruttel, and Friedrichsen (2021) observe the contrasting finding that leniency does not have an effect on cartelization. Their experimental design has the distinctive feature that a human experimental participant is placed in the role of a regulator who can award leniency at their own discretion after reviewing the content of the communication between firms. Their setup does not include a voting stage where firms choose whether or not to join a cartel, and the authors argue that not including this stage makes cartel formation more difficult. Their design also includes open communication, which they argue builds trust and reduces whistle-blowing.

Bodnar, Fremerey, Normann, and Schad (2021) are concerned with the effect of the ability to sue colluding firms for damages on the effectiveness of a leniency policy. In their leniency system, the first whistle blower receives a full fine exemption and the second receives a 50% reduction. Damages are set at 60% of the difference between the cartel and the Nash equilibrium revenues, summed over the life of the cartel. The damages are won and awarded with probability .95. All cartel members must share the costs equally. They find that private damages significantly reduce the likelihood of cartel formation. Damages also reduce the number of applications for leniency and lower prices. The study also compares structured and free-form communication, and finds that cartel stability and leniency applications are lower under chat communication, though the overall amount of collusion is higher under more restricted, structured communication.

Hamaguchi, Kawagoe, and Shibata (2009) study the how the effectiveness of leniency policies is affected by the number of firms in the industry, and by the percentage of the fine that is exempted to firms that report the cartel. They also compare a policy of granting leniency only to the first reporter versus to all reporters. Their experiment is framed as a prisoner's dilemma with two possible actions labeled with the abstract terms A and B. They observe that leniency does reduce the incidence of cartels, but that there is no difference between granting full or partial leniency, or between giving leniency to one or all reporters. They also find that giving a reward to reporters reduces the incidence of cartels more than merely granting exemptions from fines.

Hinloopen and Soetevent (2008a) investigate two-firm oligopolies in a setting with multiple equilibria. Like Hamaguchi et al. (2009), they use a two-action prisoner's dilemma, rather than a price setting framing. There are four treatments in the experiment. Under the *Benchmark* treatment, there is no penalty for collusion, Under *Antitrust*, there is a probability of detection of 40%. In the *Exploitable* treatment, there is full leniency for a firm who is the only one to report, and 90% leniency for the two firms if they both report. In the *Non-Exploitable* treatment, full leniency is given to the first applicant and 50% to the second, as in some of our treatments. The results show that in the *Exploitable* condition, firms learn to increase their earnings by colluding and then reporting on their cartel. In the *Non-Exploitable* treatment, many pairs of firms are able to collude by taking turns monopolizing the market in successive rounds of the interaction.

Feltovich and Hamaguchi (2018) are concerned with the relative power of the direct effect of whistle-blowing, which would serve to deter cartel formation, and the indirect effect of leniency lowering the cost of exiting the collusive agreement, which might make such agreements more likely. In their experiment, being caught in collusion by the competition authority is very costly and means that the firms are unable to charge high prices in any later periods. They found that leniency significantly lowered prices and reduced cartel stability. They conclude that leniency is a good anti-collusive policy.

Clemens and Rau (2019) investigate the behavior of leniency policies that exclude ringleaders from possible leniency. The idea is that doing so would discourage cartel formation. In their experiment, firms can choose to collude or not, and firms who do not collude receive the payoffs that they would as Cournot players. Firms engage in a finitely repeated game. Their design includes a baseline treatment, called *AA*. with No-leniency, and another called *LEN*, in which firms sequentially have the opportunity to report the cartel. Two other treatments, *RD2* and *RD4*, make either two or four ringleaders ineligible for leniency. The results show that discriminatory leniency policies are not effective in reducing the incidence of cartels, but they also confirm that non-discriminatory leniency is effective in doing so.

In summary, previous experimental research analyzing the effect of leniency programs on cartels generally find that leniency programs do reduce the likelihood that cartels are successful. Granting leniency to one or to multiple reporting firms does not seem to make a difference insofar as it has been directly compared. There is evidence that higher fines reduce cartel formation, whether or not a leniency policy is in place. Leniency policies reduce successful cartel formation both in paradigms in which prices are set from a relatively extensive menu of prices and those that are framed as two-or three-action social dilemmas.

3 Experiment Design

3.1 The basic setup

The structure of the experiment is based on that of Clemens and Rau (2019). Subjects are assigned to groups of four, representing four firms in a market with identical products to sell. Each group has no contact with or information about any other groups in their session. Thus, each group's activity can be considered an independent observation. Sessions consist of ten periods, and group assignments are fixed for the ten periods. Participants are made aware that their session payoffs are determined by their profits up until a randomly selected final period, plus a participation fee of $5.

At the beginning of each period, group members can talk each other in a chat box for one minute. All messages are seen by all members of the group, but not by any members of other groups. After the discussion period ends, each individual decides whether to join a cartel or not. In the experiment, this is referred to as choosing whether or not to "join the market agreement."[4] Firms make their decision before knowing how others decided. If two or more subjects agree to join a cartel, then a cartel is formed, with those who agreed to collude as the members. There is an exogenous probability of .15 that the cartel is discovered and that all cartel members are fined.

The parameters are the same as in the study of Clemens and Rau (2019), and based on the following underlying structure. There are four identical firms that produce a homogeneous good. Market demand is given by the inverse demand function $P = 100 - Q$, where Q is the quantity produced by the industry. All firms have a constant marginal cost of 60. The monopoly quantity and price are 20 and 80, respectively. If all four firms join a cartel and share the profits equally, each firm would produce 5, and receive revenue of $5 \times 80 = 400$, making a profit of $5 \times (80 - 60) = 100$. If a fine of 10% of revenue is imposed on the cartel, the fine is 40 for each firm, and each firm would receive 60 as its net payoff. In the Cournot equilibrium, each firm produces a quantity of 8, and the resulting price is 68. This results in profits of $8 \times (68 - 60) = 64$. Cartels with two or three members result in different profit vectors.

Table 1 shows the net payoffs for each player, depending on how many firms join the cartel and whether or not it is exposed. The table indicates the final period payoffs in the benchmark No-leniency (*No-len*) treatment. It shows that partial cartels of two or three firms are less profitable than the Cournot equilibrium for the cartel participants, while a full cartel of four members is the most profitable arrangement for the industry.[5]

[4] There are advantages and disadvantages to allowing this communication. Two disadvantages are that such communication is typically illegal in the field and it is difficult to model theoretically. One advantage is that is allows inexperienced players to have a chance at establishing a cartel more readily, since it allows some players to educate others about the benefits of cartelization and build confidence in each other. We felt that cartel formation would be enhanced if communication were allowed. Otherwise, the strategic uncertainty would be too strong for players to collude. We wanted to give cartels a decent chance of occurrence. In the field cartel participants might not communicate directly, but are often quite familiar with how their competitors are thinking.

[5] The payoffs assume that any firms that are not members of the current cartel behave non-cooperatively, that is, as Cournot players against the cartel and other non-cartel members.

Table 1: Period payoffs of cartel members and non-members based on size of cartel

Number of firms entering cartel	Payoff of each cartel member		Payoff of each non-member
	If cartel is not exposed	If cartel is exposed	
0	-	-	64
1	-	-	64
2	50	15	100
3	59	25	178
4	100	60	

Note: Payoffs are denominated in terms of experimental currency. 200 ECU = 1 US dollar. If all of the four firms join a cartel, the revenue of each firm is 400. If the cartel is exposed, each cartel member is fined 10% of its revenue, 40. Thus, each firm's payoff becomes $100 - 40 = 60$. Similarly, 10% of revenue is considered as the fine level for cases in which two or three firms form a cartel.

We induce time discounting with the following procedure. All groups play exactly 10 periods, but the payoffs are equivalent to those that would exist in an indefinitely repeated game with a .1 probability of termination in each period. After the 10 periods of the session are completed, we generate a sequence of random numbers which determines the probability that a given period already played would continue to count. For example, a random number is drawn for period 1 from a uniform distribution on $[0, 1]$. If the number drawn is in the interval $(.1, 1]$, periods 1 and 2 both count. Then, a random number is drawn for period 2. If this number is in $[0, .1]$, only periods 1 and 2 count. If the draw is $> .1$, period 3 also counts, and so on. If a number in $(.1, 1]$ is drawn in period 10, and the game is thus slated to continue to count, then each individual is paid an additional amount equal to the amount that they have earned in the 10 periods that have already been played. This additional payment is equal to their expected additional payment were the game to continue under the same 10% probability of ending after each period (the expected number of future periods would be 10) and assuming the same average-per-period payoffs as in the 10 periods played. Therefore, in this case, participants' total earnings for the session equal the show-up fee of \$5, plus double the amount of money that they earned in periods 1 to 10.

Though there is discounting of the future at a constant discount factor of $\delta = .9$, there is a unique subgame perfect equilibrium. This is because period 10 is certain to be the last period, and thus the game is finitely repeated. The only Nash equilibrium in period 10 is the Cournot equilibrium. Thus, the only subgame perfect equilibrium in the finitely repeated 10 period game is to play the Cournot equilibrium in each period regardless of past history. In any subgame where a cartel forms, all players blow the whistle on the cartel.

3.2 Treatments

Our design consists of a total of five treatments. The differences among the five treatments are summarized in Table 2. The benchmark treatment is called *No-len*. In this treatment, there are no leniency policies in effect, but rather an exogenous 15% probability that a cartel is discovered and fined. If exposed, the cartel is fined 10% of revenue. The *High1* treatment has two key features of the current US leniency system. (1) The treatment has a relatively high fine and (2) the first applicant for leniency is given a 100% fine exemption, with no other whistle-blowers receiving any reduction in their fines. Under the *High2* treatment, a second applicant also receives a 50% reduction in her fine, but the condition is otherwise identical to High1. Under *Low1*, only the first applicant receives a 100% fine reduction, but the fine size is only 5% of revenue. Finally, the *Low2* treatment has two features of the leniency program of South Korea. (1) The fine size is relatively low, and (2) there is a 50% fine exemption to the second applicant, in addition to 100% forgiveness to the first reporter.

In all treatments other than No-len, the game has a second decision stage after the choice of whether or not to join a cartel. In this second stage, the subjects who have joined the cartel choose whether or not to to blow the whistle on the cartel. Blowing the whistle is described to the participants as "reporting the market agreement." Firms who do not join a cartel skip this stage. If only one or none of the participants chose to join a market agreement, then this stage is also skipped, as there are no cartels that can be reported.

Under the High1 and Low1 treatments, if there is one whistle-blower, she receives full leniency and pays no fine. Thus, she receives the cartel payoff for the period. The remaining cartel members pay the fine (10% of revenue in High and 5% of revenue in Low). If there is more than one whistle-blower, only one among them, chosen randomly, receives full leniency. In High2 and Low2, two whistle-blowers, randomly chosen if there are more than two, receive leniency. One receives full leniency and pays no fine, and the second pays only 50% of his allotted fine. If there is only one whistle-blower, she receives 100% leniency.

Each firm's earnings are equal to its profits in the market minus any fines levied for participation in a cartel. After each period, each participant receives some information about activity in the period, consisting of how many firms agreed to join the cartel, how many applied for leniency, and one's own earnings.

3.3 The sessions

Each treatment is in effect for ten groups. As indicted earlier, each group has four members. Thus, in total, there are 50 groups and 200 participants in the study. The experiments are implemented via Zoom using Qualtrics. We employ an experimental currency (ECU) to denominate earnings, with each 200 ECUs exchangeable for 1 US dollar at the end of the session. The show-up fee is $5 dollars, and participants earn $12 on average. The subjects are recruited from

Table 2: Differences among the Treatments

Treatment	Existence of leniency program	Fine size (% of revenue)	Fine reduction	
			First applicant	Second applicant
No-len	No	10%	-	-
High1	Yes	10%	100%	-
High2	Yes	10%	100%	50%
Low1	Yes	5%	100%	-
Low2	Yes	5%	100%	50%

the subject pool maintained by the Economic Science Laboratory (ESL) at the University of Arizona, located in Tucson, Arizona, USA.

A session takes on average 45 minutes. Each session has two or three groups participating simultaneously. Subjects join a Zoom meeting room at the scheduled starting time of the session. They then receive a link to the experiment and are told that they would earn a show-up fee of 5 dollars and additional money depending on their decisions during the experiment. They read the instructions and are then randomly assigned to groups of four. They then proceed through the experiment.

4 Hypotheses

We rely on previously obtained experimental results to formulate hypotheses. The available previous work on cartel leniency is in near-complete agreement that leniency reduces the incidence of cartels. The variable that we use as a measure of the performance of an antitrust regime is the rate of successful cartel formation. This is defined as the percentage of periods in which a cartel is formed and not exposed, either through antitrust enforcement or whistle-blowing. We view the objective of antitrust policy to minimize this percentage of these "successful" cartels. We first hypothesize that the result obtained in prior studies would also be observed here, and that the rate of successful cartel formation would be reduced by leniency. This is tested by comparing the rate of successful cartel formation in the No-Len treatment with those in the High1 and High2 treatments, which have the same fine size in place.

Hypothesis 1 *The leniency treatments High1 and High2 have fewer successful cartels than No-Len.*

Our treatments vary whether a second whistle-blower can receive partial leniency or not. As discussed in Section 2, the available evidence is mixed regarding whether granting leniency to one or to multiple whistle-blowers is more effective in preventing cartels. The evidence is also inconclusive as to whether granting full or partial leniency makes cartels less likely. Moreover, there is no direct previous comparison between awarding full leniency to the

first party to report the cartel, and awarding full leniency to the first and partial leniency to a second whistle-blower as well. Thus, in the absence of prior evidence, we hypothesize that:

Hypothesis 2 *A leniency program that allows a second applicant a partial fine exemption leads to a similar likelihood of successful cartel formation as a program that does not. Thus, the rate of successful cartel formation is not different between High1 and High2, and not different between Low1 and Low2.*

Bigoni et al. (2015) observe that, under Bertrand competition, stronger penalties are more likely to deter cartels in the absence of leniency. They also find that the deterrent power of high penalties is magnified under leniency, since the benefits of leniency to the whistle blower increase as the fine avoided becomes larger. We thus hypothesize that higher fines lead to fewer successful cartels.

Hypothesis 3 *Under a leniency program, the rate of successful cartel formation is higher under Low1 than in High1, and higher under Low2 than in High2.*

5 Results

5.1 Leniency and Cartel Formation

We begin our reporting of the data by considering the frequency with which cartels form and how the likelihood of their formation is affected by leniency policy. Table 3 indicates the cartel formation rate, the percentage of periods in which a cartel is formed (this occurs if two or more individuals agree to join a cartel). For each treatment, the cartel formation rate is the total number of periods in which a cartel was formed, divided by 100, the total number of periods played under each treatment (10 groups times 10 periods per group in each treatment). We define a *Full Cartel* as a cartel including all four firms and a *Partial Cartel* as a cartel with two or three members. The term *All Cartels* encompasses both full and partial cartels. Table 3(a) shows the percentage of possible instances in which a cartel, either full or partial, is formed in each of the five treatments. Figure 1(a) illustrates how the cartel formation rate changes over time, by tracking the percentage of groups that form cartels in each period.

The table shows that the cartel formation rates under High2 (84%), High1 (83%), and Low1 (81%) are similar to that under No-len (85%). Low2 (95%), however has an even higher cartel formation rate than No-len. However, Mann-Whitney U tests for pairwise treatment differences between No-len and each of the other treatments are not significant. This means that the various leniency

Table 3: Cartel formation rate, by treatment

(a) All cartels

	No-len	High1	High2	Low1	Low2
Cartel formation rate*	85%	83%	84%	81%	95%

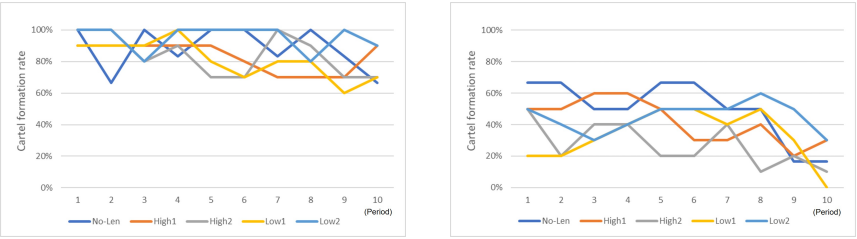
(b) Full cartels

	No-len	High1	High2	Low1	Low2
Full cartel formation rate**	49%	32%	27%	33%	45%

*Cartel formation rate = Number of Cartels formed/100 periods (= 10 periods × 10 groups per treatment)

**Full cartel formation rate = Number of full cartels formed/100 periods

Fig. 1: Cartel formation rate over the 10 periods, each treatment



(a) All cartels

(b) Full cartels

policies do not change the likelihood of cartel formation from that in No-len.[6] Indeed Figure 1 confirms that there are no obvious differences among treatments.

The data for full cartels only are shown in Table 3(b) and Figure 1(b). The full cartel formation rate in a treatment is the number of periods in which full cartels form, divided by the total number of periods. Full cartel formation

[6]In this paper, all comparisons between No-len and High1, as well as between No-len and High2, are one-sided, since we have a hypothesis (1) regarding the sign of the differences between these treatment pairs. Furthermore, all comparisons between Low2 and High2, and between Low1 and High1 are also one-sided since we also have a hypothesis (3) about differences between these two treatments. Though the hypotheses refer to the cartel success rate, the primary measure of policy effectiveness, we also use one-sided tests for the cartel formation rate, cartel exposure rate, industry profit, and fine revenue, since these are all measures that are related to the cartel success rate. Thus, we test one-sided hypotheses that High1 and High2 lead to lower cartel formation rates, higher exposure rates, lower industry profit, and greater fine revenue than No-Len. High1 exhibits the same differences relative to Low1 and High2 the same relationships with Low2. All other p-values are based on two-sided tests. In all tests, each group's activity over the 10 periods they played is taken as one observation, so that we have ten observations under each treatment. For example, in testing whether the cartel formation rate differs between two treatments, we have ten observations in each treatment, where each observation is the percentage of periods in which a group has formed a cartel in the ten periods that the group interacted.

rates are highest under No-len (49%), followed by Low2 (45%), and then in turn by Low1 (33%), High1 (32%), and High2 (27%). Figure 1 (b) shows some tendency for the incidence of full cartels to decrease in the later periods of a session. MW tests, conducted between pairs of treatments, do not show any significant differences between treatments in the percentage of instances that a full cartel forms. Thus, none of our leniency policies has an effect on the incidence of cartel formation relative to a regime of No-leniency.

5.2 The effect of leniency programs on cartel exposure and cartel success

We have seen that the leniency policies do not significantly affect the likelihood that a cartel forms. We now consider whether the leniency policies expose more of the cartels that do form. Table 4 presents the data on the *Cartel Exposure Rate*. A cartel is exposed when it is either detected by an antitrust regulator or it is revealed by a whistle-blowing action on the part of a cartel member. The cartel exposure rate is defined as the number of cartels exposed divided by the total number of cartel that are formed.

Panel (a) in the table shows that each of the four leniency treatments has a much higher cartel exposure rate than that under No-len. The cartel exposure rate is greatest under High1 (64%), followed by Low1 (60%), High2 (52%), Low2 (43%) and finally No-len (12%). MW test results, taking each group as the unit of observation, indicate that each of the four leniency programs reveals significantly more cartels than No-len (No-len vs. High1, $p = .001$; No-len vs. High2, $p = .001$; No-len vs. Low1, $p < .001$; and No-len vs. Low2, $p = .007$). However, there are no statistically significant MW test results between any pair among the four leniency treatments.[7]

Table 4(b) and Figure 2(b) include the data for full cartels only. All leniency treatments expose many more full cartels than No-len, Full cartels are exposed at the highest rate under High1 (91%), followed by Low1 (64%), High2 (59%), and Low2 (58%). Under No-len, only 14% of full cartels are exposed.

MW test results show that High1 and Low2 break more full cartels than No-len (No-len vs. High1, $p = .003$; No-len vs. Low2, $p = .032$), but other treatments are not statistically different from No-len (No-len vs. There are no statistically significant differences among the remaining treatment pairs. Thus, some leniency policies expose more cartels than No-leniency, with High1 the most effective among the policies.

A more complete measure of the performance of a cartel mitigation policy is the *Cartel Success Rate*. This is calculated as the probability that both a cartel forms and is not exposed. In such a situation, the cartel can be said to be successful since it was able to avoid detection. The rate of cartel success is thus a variable that a regulator seeks to minimize since it is a measure of

[7] For this test, the cartel exposure rate is calculated as the (number of cartels a group makes that are exposed)/(the number of cartels a group forms). Thus, for groups that do not form cartels, the variable is not defined and groups for which this is the case are not included the test. This particularly affects the comparisons of the exposure rate of full cartels, which form relatively infrequently.

Table 4: Cartel exposure rate

(a) All cartels

	No-len	High1	High2	Low1	Low2
Exposed cartels	10	53	44	49	41
by whistleblowing	-	44	36	42	33
by investigation (15% chance)	10	9	8	7	8
Cartels formed	85	83	84	81	95
Cartel exposure rate*	12%	64%	52%	60%	43%

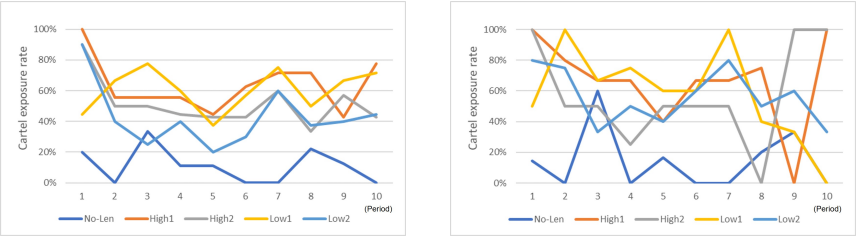
(b) Full cartels

	No-len	High1	High2	Low1	Low2
Exposed Full cartels	7	29	16	21	26
by whistleblowing	-	22	13	19	20
by investigation (15% chance)	7	7	3	2	6
Full cartels formed	49	32	27	33	45
Full cartel exposure rate**	14%	91%	59%	64%	58%

*Cartel exposure rate = Exposed cartels / Cartels formed

**Full Cartel exposure rate = Exposed Full cartels / Full cartels formed

Fig. 2: Cartel exposure rate over the 10 periods, each treatment



(a) All cartels

(b) Full cartels

undetected cartels. Table 5 and Figure 3 show the rate of cartel success in the different treatments, for all cartels as well as for full cartels only. The hypothesis presented in Section 4 were formulated in terms of this variable.

The data in the table show that the cartel success rate is higher under No-len (75%) than under any of the leniency policies. The lowest success rate occurs under High1 (30%), followed by Low1 (32%), High2 (40%) and Low2

Table 5: Cartel success rate, by treatment

(a) All cartels

	No-len	High1	High2	Low1	Low2
Cartels formed	85	83	84	81	95
Exposed cartels	10	53	44	49	41
Unexposed cartels	75	30	40	32	54
Cartel success rate*	75%	30%	40%	32%	54%

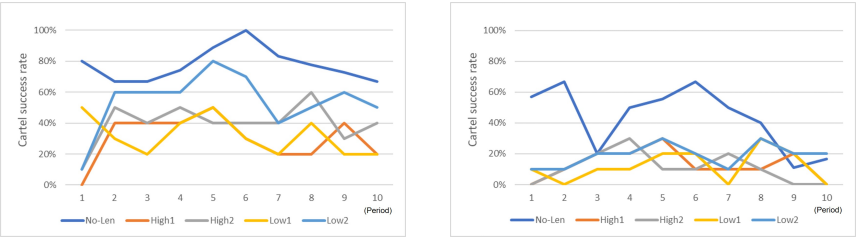
(b) Full cartels

	No-len	High1	High2	Low1	Low2
Full cartels formed	49	32	27	33	45
Exposed Full cartels	7	29	16	21	26
Unexposed Full cartels	42	3	11	12	19
Full Cartel success rate**	42%	3%	11%	12%	19%

*Cartel success rate = Number of unexposed cartels divided by 100 (= 10 periods × 10 groups per treatment)

**Full cartel success rate = Number of unexposed full cartels divided by 100

Fig. 3: Cartel success rate over the ten periods, all treatments



(a) All cartels

(b) Full cartels

(54%). As can be seen in Table A3 of Appendix A, Hypothesis 1 is supported in that the differences between No-len and the two High fine conditions are significant (No-len vs. High1 $p = .001$, No-len vs High2 $p = .004$). It is also the case that there are significantly fewer successful cartels under Low1 than in No-len. Low2 is not as effective in reducing cartel success as Low1 ($p = .036$).

High1 and High2 also lead to significantly fewer successful full cartels than No-len. This supports Hypothesis 1. There are no significant differences among the leniency policies in the full cartel success rate. All four policies yield a full cartel success rate of between 3% and 19%, compared to 42% without leniency.

5.3 Profits and fines

We now consider the overall payoffs to firms. These are increased by the successful formation of full cartels, reduced by the fines that are paid when the cartel is exposed, and increased by leniency awarded to reporters. The average profits, fines paid, and resulting payoffs to the industry, summed over the 10-periods played, by treatment, are shown in Table 6. In the table, the industry's payoff is defined as its profit minus the fines it pays. These payoffs to firms differ considerably among treatments. The highest industry payoffs are obtained in Low2, with No-len second highest. These treatments are followed by High1, Low1, and High2.

Table 6: Average industry profits, fine, and payoff, each treatment

	No-len	High1	High2	Low1	Low2
Industry Profit	3,524	3,488	3,365	3,373	3,599
Fines	136	533	346	219	200
Industry Payoff (= Profit − Fine)	3,388	2,956	3,019	3,154	3,392

MW tests show that there are no significant pairwise differences in industry profit among No-len, Low1, and Low2. (No-len vs. Low1, $p = .131$; No-len vs. Low2 $p = .880$). However, High1 and High2 do lead to significantly lower firm payoffs than No-len. (No-len vs. High1. $p = .010$; No-len vs. High2, $p = .021$). Low2 leads to greater industry payoffs than High1 ($p = .008$) or High2 ($p = .004$). Firms earn greater profit under Low1 than High1 ($p = .048$) Thus, a leniency policy lowers firms' payoffs relative to a No-leniency regime when the fine is sufficiently high. High fines reduce industry profit. Granting leniency for two whistle-blowers raises industry profit when the fine level is low.

Table 6 also indicates the average take from fines over the ten periods in each treatment. The fine revenue is greatest in High1 (533), followed by High2 (346), Low1 (219), Low2 (200) and finally by No-len (136). As can be seen in Table A4 in Appendix A, MW tests reject the hypothesis that fines are the same under No-len and High1 ($p = .001$), as well as between No-len and High2 ($p = .012$). Thus, both High1 and High2 lead to greater fines than No-len, indicating that despite the forgiveness of fines through leniency, the revenue to the authority is greater under leniency. Whether leniency is granted to one or two whistle blowers has no impact on fine revenue. Revenue under High1 is not statistically different than under High2 ($p = .112$). Low1 and Low2 also do not generate different revenue from each other ($p = .762$). Both High conditions generate greater fines than Low2 at $p < .05$, and High1 leads to more revenue than Low1 ($p = .008$).

6 Discussion

In this paper, we compare different cartel whistle-blower leniency programs. We vary the size of the fine for being caught participating in a cartel and whether one or two whistle-blowers receive leniency from penalties. We advanced three hypotheses: (i) that leniency would reduce the likelihood that firms would successfully collude, (ii) that it would make no difference whether leniency was offered to one or to two whistle-blowers, and (iii) that the larger the fine size, the fewer cartels that would be successful. The first hypothesis was strongly supported and the other two received qualified support.

In our experiment, we observe that: (1) Leniency policies do not reduce cartel formation. (2) However, they tend to expose more cartels, and thus do reduce the probability that firms successfully collude. (3) Higher fines reduce firm profits and increase the fine take to the state. (4) There is no consistent difference between the effects of awarding leniency to one or to two whistle-blowers.

Our results show that cartel formation rates are not significantly affected by leniency policies. However, leniency policies do increase cartel exposure rates through whistle-blowing. The cartel success rate, an overall measure of effectiveness in reducing cartels, refers to the likelihood that a cartel is both formed and unexposed. This is a measure that is unobservable in the field, but straightforward to measure in laboratory experiments. In the experiment, the data from High1 and High2 show that both leniency policies reduce full cartel success rates, lower firms' payoffs and increase the state's fine revenue. Hypothesis 1 is supported in the data.

Why does a leniency policy not reduce the incidence of cartels? There appear to be offsetting effects of leniency on the rate of cartel formation. Leniency reduces the incentive to form a cartel, since others may report on the collusive agreement, lowering a potential cartel member's payoffs compared to under a policy of no leniency. However, it makes a strategy of joining a cartel and subsequently blowing the whistle more attractive as well. It appears that in our data, these effects offset, and the result is that a leniency policy does not, on balance, deter attempts to form cartels. Rather than deterring cartels, a leniency policy merely causes more cartels to be exposed, and that is why they are effective in reducing cartel success.

The cartel success rates, which depend directly on how much whistle blowing occurs, are not different when leniency is granted to one or to two whistle blowers when penalties are high. While cartels enjoy a higher rate of success with two whistle-blowers when fines are low, there is no difference for the full cartels, which are the ones that are profitable. Hypothesis 2 is therefore mostly supported. It appears that a marginal incentive of a 50% reduction in the second whistle blower's fine is not a strong enough incentive to alter collusive behavior. It is rather small difference in the overall incentive to report on the cartel since it only applies if a firm one is the second whistle-blower, an event which is not very likely, and the fine reduction is only partial.

Hypothesis 3, which stated that higher fines would reduce the cartel success rate compared to lower fines, was not supported at conventional levels of statistical significance. Higher fines do reduce the incidence of successful full cartels, from 12% under a low fine to 3% under a high fine, when there is leniency for one whistle blower. If there is leniency for two whistle blowers going from a Low to a High fine reduces the cartel success rate from 19% to 11%. Similar relationships are observed for cartels overall. The effect of higher fines goes in the hypothesized direction, but does not rise to the level of statistical significance.

Our results suggest that two features of the leniency policy of South Korea, (i) its relatively low fines and (ii) leniency for two whistle-blowers rather than one, when applied together, serve to preserve industry profits and reduce fine revenue. The system may also may be ineffective in reducing the number of unexposed profitable cartels from the level that would exist under a No-Leniency policy. The Low2 treatment is the only one that does not improve upon the cartel success rate from the level in No-len. In December 2021, South Korea doubled its fine level for cartels from 10% of revenue to 20%. Our results suggest that this decision will have a positive impact on the state budget and reduce industry profit.

Appendix

We include three Appendices. The first reports a number of Mann-Whitney tests of differences of key variables between treatments. The second contains the instructions for one treatment (High1) of the experiment. The instructions for the other treatments involve only minor or obvious departures from those of High1. Appendix C consists of the payoff tables for each treatment.

Appendix A Mann-Whitney U test results for treatment differences

This section contains the MW test results reported in Section 5. Each cell in the tables below shows the p-value resulting from a MW test between a treatment indicated in one of the columns and a treatment listed in one of the rows. For example, the significance level of the test of a difference between No-len and High1 in the left panel of Table A1 is .329. Because the sample size in each treatment is small, exact p-values are used. In comparisons between No-len and one of the high fine leniency treatments, High1 or HIgh2, we use one-sided MW p-values because we hypothesize a specific difference in one direction. Similarly, we employ one-sided p-values when comparing Low1 with High1 and Low2 with High2. While some of these are unstated in Section 4, the one-sided p-values are for tests that there is lower cartel formation, higher cartel exposure, and lower cartel success in High1 and High2 than under No-len, in High1 than under Low1, and in High2 compared to Low2. We use two-sided MW test results for differences among other treatment pairs, because we do not have hypotheses about directional differences in outcome variables.

Table A1: p-values from Mann-Whitney U tests of treatment differences in cartel formation rate

	High1	High2	Low1	Low2
No-len	0.329	0.452	0.386	0.528
High1	-	1.000	0.229	0.251
High2		-	0.610	0.159
Low1			-	0.060

(a) All cartels

	High1	High2	Low1	Low2
No-len	0.500	0.132	0.300	1.000
High1	-	0.237	0.324	0.909
High2		-	0.758	0.085
Low1			-	0.425

(b) Full cartels

Table A2: p-values of Mann-Whitney U tests of pairwise treatment differences in cartel exposure rate

	High1	High2	Low1	Low2
No-len	0.001	0.001	0.000	0.007
High1	-	0.647	0.351	0.270
High2		-	0.878	0.201
Low1			-	0.543

(a) All cartels

	High1	High2	Low1	Low2
No-len	0.003	0.065	0.312	0.032
High1	-	0.205	0.075	0.105
High2		-	0.778	0.500
Low1			-	0.694

(b) Full cartels

Table A3: p-values of Mann-Whitney U tests of pairwise treatment differences in cartel success rate

	High1	High2	Low1	Low2
No-len	0.001	0.004	0.003	0.099
High1	-	0.445	0.439	0.054
High2		-	0.467	0.131
Low1			-	0.036

(a) All cartels

	High1	High2	Low1	Low2
No-len	0.031	0.028	0.062	0.301
High1	-	0.932	0.483	0.207
High2		-	0.966	0.084
Low1			-	0.192

(b) Full cartels

Table A4: p-values of Mann-Whitney U tests of pairwise treatment differences in industry payoffs and fines paid

	High1	High2	Low1	Low2
No-len	0.010	0.021	0.131	0.880
High1	-	0.496	0.048	0.008
High2		-	0.364	0.004
Low1			-	0.131

(a) Industry Profit

	High1	High2	Low1	Low2
No-len	0.001	0.012	0.197	0.172
High1	-	0.112	0.008	0.004
High2		-	0.199	0.048
Low1			-	0.762

(b) Fine

Appendix B Instructions (High1 Treatment)

General instructions

This is an experiment in economic decision making. The instructions are simple and if you follow them carefully and make good decisions, you can earn a considerable amount of money. In this experiment, your earnings will be determined by your choices, others' choices, and chance. The currency used in the experiment is the ECU, Experimental Currency Unit. The ECU that you have at the end of the experiment will be converted to dollars at a rate of 200 ECU to 1 dollar and paid to you as a bonus. In addition, you receive a show-up fee for completing the experiment. From now on until the end of the experiment, you may not communicate with any other participants outside the chatroom that we will organize.

In the experiment, you will be grouped with three other participants in a group of four people. You will remain grouped with the same three other people for the entire experiment. Each of you has the role of a company in the same four-company market. The experiment consists of 10 rounds in total, and the companies in your market will stay the same for the 10 rounds. During the experiment, you will not be able to know what person is in the role of each of the other companies. The other companies will also be unable to gain this information about you.

Each round consists of two phases. In the first phase of each round, all companies within a market can communicate with each other using a chat window. Afterward, each company announces whether it wishes to take part in the market agreement. In the second phase, each company that has joined the market agreement may choose to report the agreement.

Your earnings will depend on whether or not you choose to join the market agreement and on how many others join the agreement. Your earnings will also depend on whether or not you and other companies report the market agreement. Each round will proceed in the following manner.

Phase 1

In this first phase of each round, a chat window will appear for 60 seconds. You are able to communicate with the three other companies in your market using this chat window. You only need to type in the text that you wish to communicate. Your own text, as well as the text that other members of your group type in, will appear and can always be seen by all members of your group. It cannot be seen by any members of other groups. You can see how much time remains for the chat by looking at the top of your chat window. After 60 seconds, the chat window will disappear.

After the chat ends, a new screen will appear in which you must indicate whether or not you would like to join the market agreement. A market agreement is made if two or more companies choose to join it. Your current earnings at this point depend on how many people chose to join the market agreement.

∗ If all four companies join the market agreement: All four companies receive 100 ECU.
∗ If three companies join the market agreement and one company does not: Those who joined each receive 59 ECU. Those who do not join receive 178 ECU.
∗ If two companies join the market agreement and two companies do not: Those who joined receive 50 ECU. Those who do not join receive 100 ECU.
∗ If one company tries to join the market agreement and three companies do not: All four companies receive 64 ECU
∗ If no companies try to join the market agreement: All four companies receive 64 ECU.

Phase 2

If at least two companies have chosen to join the market agreement, an agreement is made and the round moves on to phase 2. Only those who have entered the market agreement participate in phase 2. In phase 2, each company that has entered the market agreement can choose whether or not to report the agreement. Based on whether or not you and others have reported the agreement, you may lose some of the earnings that you had at the end of phase 1.

∗ If you choose to report the agreement and you are the first to report, then you do not lose any earnings.
∗ If you choose to report the agreement but are not the first to report, then you will lose some of your phase 1 earnings. The amount you lose can be calculated using the table below.
∗ If you choose not to report the agreement but one of the other companies in the agreement reports, then you will lose some of your phase 1 earnings. The amount you lose can be calculated using the table below.
∗ If no companies in the agreement report, then there is an 85% chance that none of them will lose any earnings. However, there is a 15% chance that the agreement is discovered by a market monitor and then all of them including you lose some of your phase 1 earnings. The amount you lose can be calculated using the table below.

Those companies that have not entered the market agreement cannot report the agreement, and cannot lose any of their phase 1 earnings. If fewer than two companies join the market agreement, there is no phase 2 for the round.

How to calculate your earnings for each round

You can use the following table to help you make your decisions. The rows in the table correspond to the number of companies in your market that have chosen to enter the market agreement. The first column shows the number of companies that have entered the market agreement. Column 2 shows the phase one payoff if you enter the market agreement and how it depends on how many other companies have also entered the agreement. Column 3 contains

your final earnings for the round if no company reports the agreement or if you are the first to report the agreement. In these cases, your final earnings for the round are equal to your phase 1 earnings. In the fourth column, you can see what you earn if another company is the first to report or if the agreement is discovered by a market monitor. Finally, column 5 shows your earnings if you do not enter the agreement.

How many rounds count toward your 'final earnings'

In the experiment, you will participate in 10 rounds. However, they may not all count toward your earnings. Imagine that a 10-sided die, with each number 1 to 10 on exactly one side, is rolled after each round. If it comes up 1, the round that has just finished becomes the last round that counts toward your earnings. If the die comes up 2, 3,..., 10, the next round also counts. Therefore, there is always a 90% chance that the next round counts, no matter what round you are currently playing. This means that there is a 100% chance that round 1 will count, a 90% chance that round 2 will count, a $0.9 \times 0.9 = 81\%$ chance that round 3 will count, a $(0.9)^3 = 73\%$ chance that round three will count, etc.

You do not see these die rolls, and you will not know which round is the last one that counts until the experiment ends. If the die does not come up 1 for 10 rounds, then you will receive the earnings from all 10 rounds you play, as well as an additional amount equal to your earnings for the 10 rounds. So in that case, you get 2 times your earnings over the 10 rounds. There is a 35% chance of this occurring.

Let's wait for other players by clicking "Next" and start the game!

Appendix C Payoff tables of the treatments

The payoff tables below were those used in the experiment. All payoffs in the tables are firms' "Payoffs" calculated as "individual firm profits minus fines paid" for each case. For example, in Figure A2, suppose three firms join a cartel and one firm does not. Then, the one who does not join a cartel obtains 178 and three firms in the cartel will get either 59 or 25. If no firms blow the whistle the cartel members each obtain 59. If one of them becomes the first or only whistle-blower, they also obtain 59. If another firm blows the whistle first or the cartel is uncovered by a regulator's monitoring, then the firms in the cartel get 25. The other situations and the other tables are read and interpreted similarly.

Number of Companies entering market agreement	**If you enter the market agreement**		**If you do not enter the market agreement**
	Participation stage earnings are (in ECU)	If the agreement is discovered by a market monitor with 15% chance, your final earnings for the round are	Final earnings for the round are (in ECU)
0	-	-	64
1	-	-	64
2	50	15	100
3	59	25	178
4	100	60	-

Fig. A1: The payoff table for the No-len treatment

Number of Companies entering market agreement	**If you enter the market agreement**			**If you do not enter the market agreement**
	Phase 1 earnings (in ECU)	Final earnings for the round (in ECU)		Final earnings for the round (in ECU)
(Column 1)	(Column 2)	If no company reports or if you are first to report the agreement (Column 3)	If another company is the first to report the agreement OR If the agreement is discovered by a market monitor with 15% chance, (Column 4)	(Column 5)
0	-	-	-	64
1	-	-	-	64
2	50	50	15	100
3	59	59	25	178
4	100	100	60	-

Fig. A2: The payoff table for the High1 treatment

Number of Companies entering market agreement	**If you enter the market agreement**				**If you do not enter the market agreement**
	Phase 1 earnings (in ECU)	Final earnings for the round (in ECU)			Final earnings for the round (in ECU)
(Column 1)	(Column 2)	If no company reports OR If you are first to report the agreement (Column 3)	If you are second to report the agreement (Column 4)	If you are not the first or second to report and any company reports the agreement OR If the agreement is discovered by a market monitor with 15% chance, (Column 5)	(Column 6)
0	-	-	-	-	64
1	-	-	-	-	64
2	50	50	15	15	100
3	59	59	42	25	178
4	100	100	80	60	-

Fig. A3: The payoff table for the High2 treatment

Number of Companies entering market agreement	**If you enter the market agreement**			**If you do not enter the market agreement**
	Phase 1 earnings (in ECU)	Final earnings for the round (in ECU)		Final earnings for the round (in ECU)
(Column 1)	(Column 2)	If no company reports or if you are first to report the agreement (Column 3)	If another company is the first to report the agreement OR If the agreement is discovered by a market monitor with 15% chance, (Column 4)	(Column 5)
0	-	-	-	64
1	-	-	-	64
2	50	50	32.5	100
3	59	59	42	178
4	100	100	80	-

Fig. A4: The payoff table for the Low1 treatment

Number of Companies entering market agreement	**If you enter the market agreement**				**If you do not enter the market agreement**
	Phase 1 earnings (in ECU)	Final earnings for the round (in ECU)			Final earnings for the round (in ECU)
(Column 1)	(Column 2)	If no company reports OR If you are first to report the agreement (Column 3)	If you are second to report the agreement (Column 4)	If you are not the first or second to report and any company reports the agreement OR If the agreement is discovered by a market monitor with 15% chance, (Column 5)	(Column 6)
0	-	-	-	-	64
1	-	-	-	-	64
2	50	50	32.5	32.5	100
3	59	59	51.5	42	178
4	100	100	90	80	-

Fig. A5: The payoff table for the Low2 treatment

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