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## Leniency programs in a multimarket setting: amnesty plus and penalty plus

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# LENIENCY PROGRAMS IN A MULTIMARKET SETTING: AMNESTY PLUS AND PENALTY PLUS

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# LENIENCY PROGRAMS IN A MULTIMARKET SETTING: AMNESTY PLUS AND PENALTY PLUS

## Abstract

We examine the effects of Amnesty Plus and Penalty Plus, influencing firms' whistle blowing incentives in one market, on their self-reporting decision in another market. Amnesty Plus and Penalty Plus are proactive US strategies which aim at triggering multiple confessions by increasing the incentives of already convicted firms to report in another market where they collude. Predictably, conditional on conviction of one cartel, Amnesty Plus and Penalty Plus strengthen firms' incentives to report the remaining cartel. However, Amnesty Plus and Penalty Plus have an ambiguous impact on firms' incentives to apply for amnesty in the first place: On the one hand, Amnesty Plus and Penalty Plus may help to sustain a cartel, otherwise reported under the EC policy. On the other hand, Amnesty Plus and Penalty Plus may induce immediate reporting of both cartels whereas only one of them would have been reported under the EC Leniency Program.

JEL Code: K21, K42, L41.

Keywords: Amnesty Plus, self-reporting, antitrust, multimarket contact.

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*“Good experience with citric acid. Next opportunity [vitamin] B2. We think it’s worth that we explore all possibilities of cooperation. Let’s explore cooperation product-by-product.” (Kuno Sommer, Hoffmann-LaRoche, quoted in New York Times 10/10/99)*

## 1 Introduction

This paper analyzes the potential of leniency - respectively amnesty - programs allowing for *Amnesty Plus* and *Penalty Plus* to create incentives for companies, which are simultaneously participating in multiple cartel activities, to reveal the entire range of their antitrust offenses. In particular, we examine the impact of Amnesty Plus and Penalty Plus, influencing firms’ whistle-blowing incentives in one market, on their self-reporting decision in another market.

Experience garnered over many years has taught antitrust authorities in the United States (US) and the European Union (EU) that companies which have been colluding in one specific product or geographic market are more likely to have engaged in, or at least to know about, cartel activities in other adjacent markets. Due to the high diversity of businesses in multinational firms, price-fixing and market allocation conspiracies bear all the marks of contagion between and especially within companies. The cross-linked conspiracy pattern in various vitamins, citric acid and lysine is a well-known subject matter and helps to illustrate this claim:

During ten years, Hoffmann-LaRoche (HLR) was simultaneously active in virtually all cartels affecting the whole extent of bulk vitamin production, i.e. vitamins A, E, B1, B2, B5, B6, folic acid, C, D3, H, beta carotene and carotinoids. The first main group of cartels consisted of price fixing agreements in the markets for vitamin A and E between HLR, BASF and Rhône-Poulenc. The initial success of these arrangements inspired their replication in other vitamin markets. In these second-wave cartels, firms such as e.g. Merck, Takeda and Daiichi, simultaneously colluding in at least one other vitamin, joined the pioneers (Connor 2000, EC IP/01/1625 November 2001). While Rhône-Poulenc’s disclosure of evidence on collusion in the vitamin A and E markets made the cartel’s wall of silence crumble, only BASF’s comprehensive collaboration with the US Department of Justice (DoJ) under the Amnesty Plus Program accelerated inquiries and finally led to the successful prosecution of all participants. Accordingly, the European Commission (EC) stated that “the simultaneous existence of the collusive arrangements in the various vitamins was not a spontaneous or haphazard development,

but was conceived and directed by the same persons at the most senior levels of the companies concerned” (EC IP/01/1625 November 2001). Surprisingly, when Rhône-Poulenc plead guilty to its vitamin conspiracies under the US Amnesty Program<sup>1</sup> and applied for leniency under the 1996 EC Notice<sup>2</sup>, it pursued cartel activities in methionine and methylglucamine (EC IP/01/1625 November 2001, EC IP/02/976 July 2002 and EC IP/02/1746 November 2002).

During the vitamin conspiracy, HLR was acting as a co-leader of the citric acid cartel, the world’s most widespread acidulent and preservative used in the food and beverage industry, at the side of Archer Daniels Midland (ADM). In 1997, at the time of HLR’s conviction under US antitrust law for its participation in the citric acid conspiracy, the Division informed the company about the ongoing investigations in the vitamin market and even asked for its cooperation in return for lenient treatment. However, instead of assisting the DoJ in its inquiries, not only did HLR’s top executives, engaged in the citric acid conspiracy and holding at the same time important responsibilities in the vitamin business, boldly deny any knowledge of, or participation in, a vitamin cartel, but also they sharply increased their efforts to conceal illegal arrangements (Hammond 2000, Barboza 1999). In 1997, shortly after ADM had plead guilty for criminal price fixing in citric acid, HLR and Jungbunzlauer AG (JBL) agreed to plea-bargain and to pay fines totaling \$25 million. At the same time, ADM and JBL engaged in price fixing and market sharing in sodium gluconate (EC IP/01/1743 December 2001).

In 1995, two years before the citric acid cartel was exposed, dawn raids in the headquarters of ADM, the largest US processor of agricultural commodities, produced hard evidence of collusive arrangements in lysine, an essential amino acid. Documents and video tapes contained references to the citric acid conspiracy. Thus, the investigation in lysine directly yielded information on the citric acid collusion. The illegal price-fixing and market sharing agreements in lysine were initiated by ADM in 1992 and discovered by the public in 1995 (Connor 2000, EC IP/00/589 June 2000). Besides ADM were involved its Asian rivals Ajinomoto, Cheil, Kyowa and Sewon. In 1996, the Asian lysine producers plead guilty and agreed to cooperate with the DoJ and to testify against ADM in return for lenient treatment. Just after the adoption of the 1996 EC Leniency Notice, Ajinomoto decided to inform the EC on the cartel and qualified for a 50% discount in fines. Interestingly, at the time Ajinomoto came forward, it was involved in another global conspiracy in the market for nucleotides lasting until mid 1996 when it was unveiled by its accomplice Takeda, itself under investigation for participation in the vitamin cartel case (EC IP/02/1907 December 2002).

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<sup>1</sup>Corporate Leniency Policy 1993. Available at: <http://www.usdoj.gov/atr/public/guidelines/0091.htm>

<sup>2</sup>1996 Notice on Immunity from Fines and Reduction of Fines in Cartel Cases, OJ C 207, 18 July 1996.

In the US, convictions of global cartels in the 1990s suggest that at least a dozen firms have become repeated offenders in related product industries (Connor 2003). The DoJ has been investigating around 50 alleged international cartels in 2004, and half of them have been detected during inquiries on separate markets (Hammond 2004). These so-called ‘rolling investigations’ and ‘cartel profiling’ techniques are the DoJ’s response to companies’ recidivism. With the objective of fully exploiting these patterns of contagious conspiracies, the DoJ implemented the Amnesty - respectively Penalty - Plus Program in 1999 as part of the Division’s Corporate Leniency Policy (Spratling 1999). According to Hammond, “The Division’s Amnesty Plus program creates an attractive inducement for encouraging companies who are *already under investigation* to report the full extent of their antitrust crimes [...]” (Hammond 2004:16).

Leniency programs reduce fines for cartel members that bring evidence to the antitrust authority. Amnesty refers to the complete exemption from fines. Amnesty Plus and Penalty Plus comprise proactive strategies aimed at attracting amnesty applications by encouraging subjects of ongoing investigations to consider whether they qualify for amnesty in other than currently inspected markets where they engage in cartel activities. Amnesty Plus offers a firm which currently plea-bargains an agreement for participation in one illegal antitrust activity, where it cannot obtain guaranteed amnesty, complete immunity in a second cartel affecting another market. Thus, provided that the firm agrees to fully cooperate in the investigation of the conspiracy of which the DoJ was previously not aware, it is automatically granted amnesty for this second offense. Moreover, the company benefits from a substantial additional discount, i.e. the Plus, in the calculation of its fine in any plea agreement for the initial matter under investigation<sup>3</sup>. The counterpart of Amnesty Plus is Penalty Plus, or equivalently “If Amnesty Plus is the carrot, ‘Penalty Plus’ is the stick.” (Spratling and Jarett Arp 2003:29). If companies that neglect to take advantage of Amnesty Plus are nevertheless caught for a second time, their behavior is more severely fined than it would otherwise merit. The company’s knowing failure to report aggravates the punishment, not only increasing the size of the fine but also the length of the jail sentence for its executives<sup>4</sup>.

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<sup>3</sup>The size of the additional discount mainly depends on three factors: The strength of the evidence provided by the cooperating company, the potential significance of the revealed case measured in terms of volume of commerce involved, geographic scope and the number of co-conspirators, and the likelihood that the DoJ would have detected the cartel absent self-reporting (Hammond 2006).

<sup>4</sup>The DoJ does not state an exact percentage increase in the case of Penalty Plus but asserts to pursue a fine or jail sentence at or above the upper end of the Guidelines Range (Hammond 2006). An example of Penalty Plus is the DoJ’s fining decision in monochloroacetic acid in 2003. The German company Hoechst AG was fined roughly 130% above the minimum guideline fine due to its failure to report the illegal agreement in monochloroacetic acid at the time it was convicted for its participation in the sorbates cartel (Hammond 2004).

Under the current EC Leniency Notice, Amnesty Plus and Penalty Plus do not exist. Although, in 2001, the Organization for Economic Co-operation and Development (OECD) recommended the inclusion of Amnesty Plus as part of the 2002 reforms of the EC Leniency Program<sup>5</sup>, the EC did not seize the opportunity to follow the US example by introducing a similar policy.

The main objective of the present analysis is to shed light on the issue of reporting incentives under an Amnesty Program when the same firms participate in cartels in more than only one market. Unsurprisingly, conditional on cartel conviction in one of the markets, Amnesty Plus and Penalty Plus strengthen firms' reporting incentives in the other market. However, Amnesty Plus and Penalty Plus have an ambiguous impact on firms' incentives to apply for amnesty in the first place:

On the one hand, firms are less willing to denounce a cartel, otherwise reported under the EC policy, if this would entail revelation of a second cartel; especially if the latter is very profitable. In particular, if, by reporting one of their infringements, firms have to sacrifice sufficiently high expected cartel profits in the other market, Amnesty Plus and Penalty Plus help to sustain collusion in both markets. Moreover, since the beneficial effect of Amnesty Plus and Penalty Plus operates only after a conviction in one market, less spontaneous reporting may compromise the very functioning of this policy.

On the other hand, Amnesty Plus and Penalty Plus may also lead to immediate self-reporting in both markets. Firms, fearing that, after reporting one, their partner reveals the other cartel, would prefer to forthwith report both cartels. This desirable effect occurs if expected cartel profits in one market are not sufficient to compensate for forgoing leniency in the other market. We base our arguments on an analysis of a two-stage game between two symmetric firms, simultaneously colluding in two distinct product markets, say *A* and *B*, and the Antitrust Authority (AA). To act as a benchmark, we initially examine firms' reporting incentives under a standard amnesty policy which comprises neither Amnesty Plus nor Penalty Plus as it currently is the case in the EU. Then, we analyze how these revelation decisions change under a US style amnesty policy where Amnesty Plus exists. Finally, we add Penalty Plus and show not only that our results still hold but also that Penalty Plus may even strengthen our findings.

The study of the possible impact of Amnesty Plus and Penalty Plus on firms' incentives to self-report has been exclusively left to legal scholars. Jephcott (2002) is first to highlight the lack of an equivalent to the US Amnesty Plus option in the 2002

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<sup>5</sup>Commission Notice on Immunity from Fines and Reduction of Fines in Cartel Cases, 2002/C 45/03, 19 February 2002. Available at: <http://europa.eu.int/comm/competition/antitrust/leniency/>.

EC Leniency Notice. McElwee (2004) argues that Amnesty Plus and Penalty Plus intensify the ‘race to the courtroom’ dynamics<sup>6</sup> and thus generate distrust among cartel members. Moreover, companies volunteering information on their participation in other cartels during an investigation on a distinct product or geographic market appear to be rare. This seems especially true for antitrust regimes under which the altruism of companies is not substantially rewarded. Even though exceptions may occasionally exist<sup>7</sup>, the author recommends the introduction of a leniency policy similar to the US Amnesty Plus and Penalty Plus in Europe.

Although the law literature on the subject is burgeoning, to our knowledge, there is no economic analysis which tries to clarify possible motifs for the EC’s non-adoption of Amnesty Plus and Penalty Plus policies, let alone to model the role of leniency programs when companies commit multiple antitrust offenses. We take the first step towards filling this gap in economic theory on leniency programs.

The remainder of the paper is organized as follows. Section 2 briefly reviews the economic literature related to our analysis. Section 3 introduces the main features of our model. The second stage of the revelation game and its equilibrium outcomes are discussed in section 4. In section 5, we examine the first stage of the game. In section 6, we add Penalty Plus and show how it affects our findings. Section 7 concludes.

## 2 Related Literature

The enforcement problem we study essentially relates to two different strands of literature. On the one hand, our paper is embedded in the analysis of how the design of leniency programs influences the internal stability of collusive agreements involving a group of violators, pioneered by Motta and Polo (2003). On the other hand, our analysis is motivated by the study of how multimarket contact affects the degree of cooperation among firms. Literature on collusion in a multimarket context started with the seminal paper of Bernheim and Whinston (1990).

Our analysis is closest in purpose to current economic leniency literature in that we attempt to assess how the design of leniency programs affects cartel stability. Recent

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<sup>6</sup>Under the US Amnesty Program, only the first reporting firm is eligible to full immunity from fines. The so-called ‘winner-takes-it-all’ approach sets up a race among firms competing for being first to denounce the cartel to the AA.

<sup>7</sup>In the Belgian Beer Brewers’ cartel, Interbrew, one of the colluding companies under investigation, spontaneously disclosed a simultaneously existing illegal agreement between Luxembourg brewers though it could not benefit from an additional fine discount in the Belgian Beer market, e.g. for particularly extensive cooperation, as it would under US Amnesty Plus (EC IP/01/1739 December 2001, EC IP/01/1740 December 2001).



academic research - such as Harrington (2005), Aubert, Kovacic and Rey (2003), Motta and Polo (2003), Spagnolo (2003) and Hinlopen (2002) - has elaborated on the differences in conception of leniency programs and their impact on the efficacy of antitrust enforcement<sup>8</sup>. However, no economic research has been conducted on how Amnesty Plus and Penalty Plus influence firms' cartel activities.

Our model differs from conventional ones, where firms collude in one market only, in that we analyze firms' simultaneous participation in several collusive agreements. Spagnolo (2003), by modeling harsher fines for recidivist firms, is the only study on leniency programs which touches upon recidivism. In his analysis, higher sanctions for recurrent antitrust offenders rationalize the use of reduced fine schemes when firms follow an optimal two-phase punishment. Reporting raises fines and reduces expected profits from further collusion, limiting the costs firms are willing to incur to punish the whistleblower defecting from the cartel in the first place. However, whereas we would like to capture the idea of recidivism by the firms' opportunity, following a successful investigation in one market, to continue price-fixing in another market, the author does not aim at analyzing simultaneous participation in multiple cartel activities .

Motchenkova and van der Laan (2005) are first to explicitly acknowledge the importance of firms' degree of diversification and their multimarket operations within a leniency framework. They use the multimarket context in order to examine the effectiveness of leniency rules, given that firms, admitting their collusive conduct, incur costs other than fines. These additional costs are modeled as the loss in sales in markets, other than the one involved in illegal behavior, due to negative reputation effects following a cartel conviction. Therefore, the authors assume firms to operate in different markets but to form a cartel in one market only. Moreover, the focus of the study is on the strictness of leniency programs reflecting the likelihood of getting full immunity from fines even in case many firms self-report simultaneously and hence, it fundamentally differs from ours.

Another noteworthy difference from the above literature is that, in our model, cartels do not take the form of ongoing criminal relations. This is in line with Feess and Walzl (2004) who build a static model and Spagnolo (2000) who examines one-shot market interactions. Although our model is static, the intuition behind the results is likely to apply also to dynamic environments.

Finally, most of the leniency literature focuses on the potential of leniency programs to deter collusion *ex ante*. We presume that cartels have already been formed and instead concentrate on the issue of *ex post* desistance. However, since greater desistance makes collusion less profitable, desistance is pertinent to deterrence and thereby enhances *ex ante* deterrence (Harrington 2005).

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<sup>8</sup>For an extensive overview of economic literature on leniency programs see Spagnolo (2005).

Our analysis has essentially been inspired by Bernheim and Whinston (1990) who build on the idea, first raised by Edwards (1955) and further developed in a finite oligopoly games context by Harrington (1987), that multimarket contact across firms could foster anticompetitive outcomes. The authors show that strategically linking markets weakly increases cartel profits because it slackens the incentive constraints that limit firms' ability to sustain collusive behavior in settings of repeated interactions. Their technical result coincides with the intuition that multimarket contact allows for linkage-induced punishment which can deter deviations from collusive behavior. Apart from the main idea of the above studies, namely that multimarket contact between firms may influence collusive outcomes, the setup of our model is different. Moreover, in our analysis, multimarket contact alone does not affect collusive behavior. It is Amnesty Plus and Penalty Plus which create the link between firms' reporting decisions in the markets where they collude.

### 3 The Model

#### 3.1 Basic Assumptions

We model the interaction between two symmetric firms, F1 and F2, simultaneously engaged in cartel activities in two distinct product markets,  $A$  and  $B$ , which may differ in size and profitability, and the AA. We compare firms' revelation decision under the EC Leniency and the US Amnesty Program whose sole difference is that the latter allows for Amnesty Plus and Penalty Plus. In this simple setting, Amnesty Plus signifies that a firm which has been caught colluding in one market, either through reporting of its co-conspirator or through the investigation efforts of the AA, can avoid the full fine in this market by reporting the remaining cartel in the other market. Penalty Plus increases the fine for a recidivist firm.

The strictness of the enforcement policy is summarized by independent market-specific investigation probabilities,  $q_A$  and  $q_B$ , with which the AA opens an inquiry leading to the conviction of colluding firms with certainty. At the time firms decide to enter an illegal agreement, they cannot directly observe investigation probabilities. However, firms conjecture the strictness of the AA's enforcement policy based on a market-specific combination of observable variables which determine current antitrust policy. Firms' ex ante conjectures of detection probabilities,  $\bar{q}_A$  and  $\bar{q}_B$ , are the expected values of ex post investigation probabilities. Before the start of the game, these conjectures are such that forming a cartel is profitable. However, probabilities of being convicted may

change over time. Potential reasons could be complaints from consumers, employees revealing information to the AA, a shift in the AA's budget constraint which affects available resources and efforts devoted to antitrust enforcement in the different product markets or simply changes in the way the AA operates.

Firms simultaneously decide whether to self-report or not,  $S$  resp.  $NS$ , as a function of conviction probabilities, cartel profits and fines. Let us denote  $\Pi_A$  ( $\Pi_B$ ) the cartel profits in market  $A$  ( $B$ ) and  $\Pi_N$  the non-cooperative Bertrand-Nash profit obtained during compliance with the law in each market. Without loss of generality, we set  $\Pi_N = 0$  and assume that  $\Pi_A, \Pi_B > 0$ .

### 3.2 Enforcement Choices

The AA commits to its enforcement policy by setting

- the full fine,  $F_A$  resp.  $F_B$ , per cartel detected and successfully prosecuted, imposed on a non-reporting firm and exogenously given by law.
- the reduced fine for a self-reporting firm which is equal to 0. Only the first self-reporting firm is eligible to amnesty. The latecomer pays the full fine. When both firms report simultaneously, each is first in 50% of the time.
- the increased fine,  $(1 + \alpha)F_A$  resp.  $(1 + \alpha)F_B$ , under Penalty Plus where  $\alpha > 0$ . The parameter  $\alpha$  reflects the increase in the fine a firm has to pay when convicted in one market after prior detection in another market.
- the supplementary reduction in fines due to Amnesty Plus which equals the entire fine previously imposed.

### 3.3 Timing

The model is static. There is only one period which is divided into two stages. Before the start of the game, at the beginning of period zero, the AA sets  $F_A$  and  $F_B$ . At the same time, Nature chooses the order in which a possible investigation takes place, and firms observe this. If no cartel has been reported, the AA will first investigate and discover  $A$  with probability  $q_A$  before starting an inquiry in  $B$  with probability  $q_B$ . When forming a cartel, firms conjecture market-specific conviction probabilities  $\bar{q}_A$  and  $\bar{q}_B$  which are such that they find it profitable to collude in both markets. At the end of period zero, both firms receive market-specific signals which make them revise their subjective detection probabilities from  $\bar{q}_{A,B}$  to  $q_{A,B}$ . Subjective probabilities are identical for both firms. The shift in detection probabilities might make firms consider

whether they wish to spontaneously report one or both cartels to the AA. If  $q_{A,B} \leq \bar{q}_{A,B}$ , collusion is still profitable and firms have no incentives to desist from cartel activities by revealing information to the AA. Thus, the only cases relevant to our analysis result from an investigation probability increase such that  $q_{A,B} > \bar{q}_{A,B}$  in at least one of the markets. Figure 1 shows the time structure of the game.

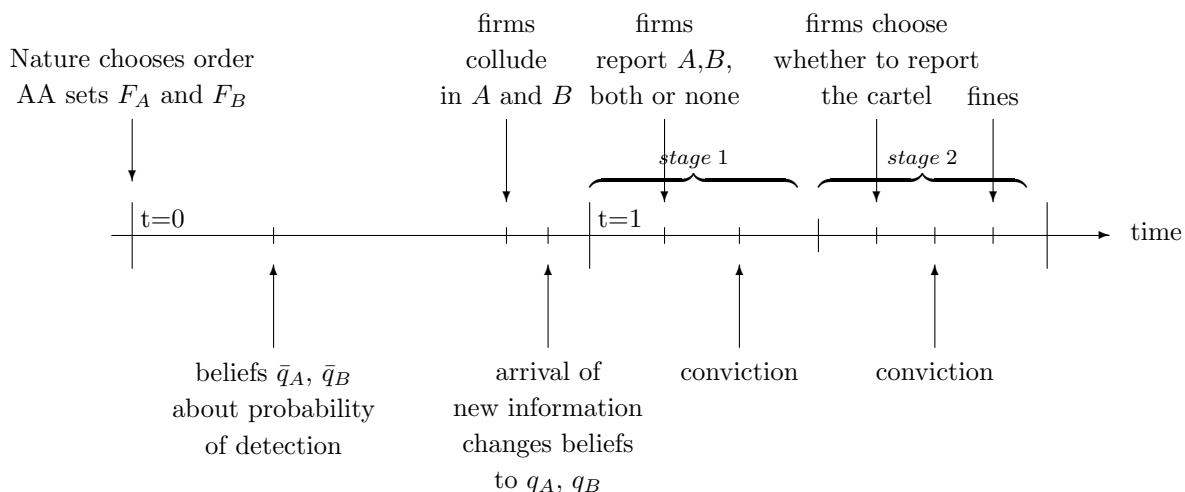


Figure 1: Time Line

- **Stage 1: Revelation Decision in Both Markets**

Firms simultaneously decide whether to report one, both or none of the cartels.

1. If both cartels are reported, the AA convicts each cartel with certainty. The game does not reach stage 2.
2. If at least one of the firms reports one cartel, the AA convicts this cartel with certainty. The game moves on to stage 2 where firms simultaneously decide whether to report the remaining cartel.
3. If firms do not reveal any information, the AA detects the cartel in  $A$  with probability  $q_A$ , and firms reconsider their decision whether or not to report the cartel in  $B$ . Hence, if the AA convicts the cartel in  $A$ , the game moves on to stage 2. With probability  $1 - q_A$ , the cartel in  $A$  remains undetected, and the game does not reach stage 2. In this case, the AA investigates and detects the cartel in  $B$  with probability  $q_B$ .

- **Stage 2: Reconsideration of Revelation Decision**

The game only reaches stage 2 if one of the cartel has survived stage 1. Firms simultaneously decide whether to report the cartel in the market where the AA has not yet launched an investigation. If they do not report, the AA convicts the cartel with probability  $q_A$  resp.  $q_B$ . Fines are paid and payoffs realized.

## 4 Reporting Decision in Stage 2

### 4.1 EC Leniency Program without Amnesty Plus

The game reaches stage 2 only after one cartel conviction in stage 1. When analyzing stage 1 in section 5, we will be interested in unilateral deviations from cooperation. Therefore, we fix the collusive behavior of F1 in stage 1. Three different scenarios lead to stage 2. First, neither firm reports, the AA investigates and detects the cartel in  $A$  which happens with probability  $q_A$ . Second, F2 denounces the cartel in  $A$  but keeps secret the cartel in  $B$ . Finally, F2 reveals the cartel in  $B$  but continues colluding in  $A$ . Proceeding by backward induction, we examine the normal form of the revelation game in stage 2 after each possible outcome in stage 1. Both firms reporting constitutes the Nash Equilibrium (NE) only if, for given fines and cartel profits, the probability of being convicted in stage 2 exceeds the probability threshold which makes an unilateral deviation from cooperation just unprofitable. Put differently, the probability threshold is such that the expected cartel profits in the remaining market are zero. Figure 2 depicts this situation under the EC policy. We only look at pure strategy NE.

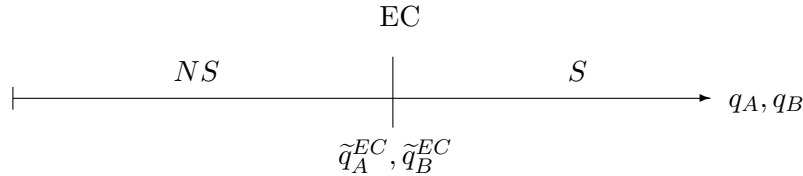


Figure 2: Stage 2 Reporting Decisions in the EC

Above the threshold, expected profits in stage 2 are negative, and firms simultaneously report the cartel. The outcome  $(S, S)$  is the unique NE. However, below the critical probability,  $(S, S)$  and  $(NS, NS)$  are both pure strategy NE, but the latter Pareto dominates the former. If the game has two NE, firms coordinate on the Pareto dominating outcome and do not report.

To find the thresholds, we first consider the situation where firms did not report any of the cartels in stage 1, but the AA detected the cartel in  $A$ . The payoff matrix in Table 1 summarizes the revelation game played in stage 2. F1's possible actions are written vertically, whereas those of F2 are written horizontally. Setting  $\Pi_N = 0$ , the outcome  $(S_B, S_B)$  is the unique NE only if  $q_B > \frac{\Pi_B}{\Pi_B + F_B} = \tilde{q}_B^{EC}$ . Firms may get caught in the cartel activity, earn zero profits and pay a fine with a high probability. Therefore, expected cartel profits are negative, which is enough to make a deviation from the cooperative NE attractive.

[Table 1 about here.]

Second, consider the payoff matrix in Table 2 which summarizes the revelation game played in market  $B$  in stage 2 after F2 reported the cartel  $A$  in stage 1. Again, expected cartel profits are negative, and the outcome  $(S_B, S_B)$  is the unique NE only if  $q_B > \frac{\Pi_B}{\Pi_B + F_B} = \tilde{q}_B^{EC}$ .

[Table 2 about here.]

Finally, given that F2 already reported the cartel  $B$  in stage 1, the payoff matrix in Table 3 summarizes the revelation game played in market  $A$  in stage 2. The outcome  $(S_A, S_A)$  is the unique NE only if  $q_A > \frac{\Pi_A}{\Pi_A + F_A} = \tilde{q}_A^{EC}$ .

[Table 3 about here.]

An increase in the fine non-reporting firms would have to pay in the case of a conviction in stage 2 decreases the investigation probability needed to induce self-reporting. On the contrary, higher cartel profits in stage 2 raise the critical probability thresholds.

## 4.2 US Amnesty Program with Amnesty Plus

The analysis is analogous to the EC case. The same three scenarios in stage 1 lead to stage 2. Each of them involves one cartel conviction in stage 1. However, firms' payoffs from deviation and with them their reporting incentives in each subgame change with respect to the EU. Since Amnesty Plus links markets, the outcome in market  $A$  affects reporting decisions in market  $B$ . A firm, once convicted in market  $A$ , has stronger incentives to denounce the cartel in market  $B$  to avoid the fine in  $A$ . Thus, the collusive NE is easier to break than under the EC policy where markets are independent, and actions taken in one of the markets do not affect firms' decisions in the other market. Figure 3 shows the probability thresholds in the US.

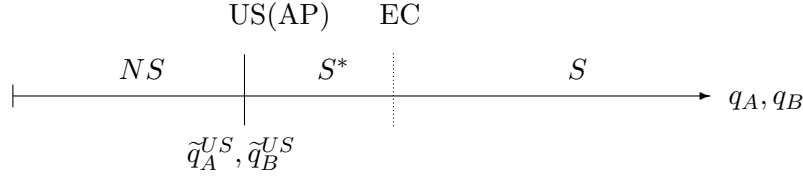


Figure 3: Stage 2 Reporting Decisions in the US, Amnesty Plus

Above the critical probability, firms report the cartel in stage 2. The threshold is lower and thus, the probability range for which the outcome  $(S, S)$  is the unique NE is larger in the US than in the EU. In the region  $S^*$ , the EC policy would have sustained the cooperative NE whereas in the US, Amnesty Plus offers a profitable deviation to a firm which has been fined in stage 1. Therefore, conditional on conviction in stage 1, Amnesty Plus enhances reporting in stage 2. Still, below the critical probability, firms coordinate on the cooperative outcome and do not report the remaining cartel.

To compute the thresholds, we first consider the payoff matrix in Table 4 which summarizes the revelation game played in stage 2 when the AA caught both firms colluding in  $A$  in stage 1. The outcome  $(S_B, S_B)$  is the unique NE only if  $q_B > \frac{\Pi_B - F_A}{\Pi_B + F_B} = \tilde{q}_B^{US}$ .

[Table 4 about here.]

Second, given that F2 reported the cartel  $A$  in stage 1, the payoff matrix in Table 5 summarizes the revelation game played in market  $B$  in stage 2. Again, the outcome  $(S_B, S_B)$  is the unique NE only if  $q_B > \frac{\Pi_B - F_A}{\Pi_B + F_B} = \tilde{q}_B^{US}$ .

[Table 5 about here.]

Finally, the payoff matrix in Table 6 summarizes the revelation game played in market  $A$  in stage 2 when F2 reported the cartel  $B$  in stage 1. The outcome  $(S_A, S_A)$  is the unique NE only if  $q_A > \frac{\Pi_A - F_B}{\Pi_A + F_A} = \tilde{q}_A^{US}$ .

[Table 6 about here.]

All probability thresholds are unambiguously lower than their counterparts in Europe. They decrease even further when the size of the fine firms can avoid under Amnesty Plus increases.

## 5 Reporting Decision in Stage 1

When simultaneously deciding whether to report in stage 1, firms anticipate the NE played in stage 2. Figures 4 and 5 show firms' reporting decisions in the EU and the US.

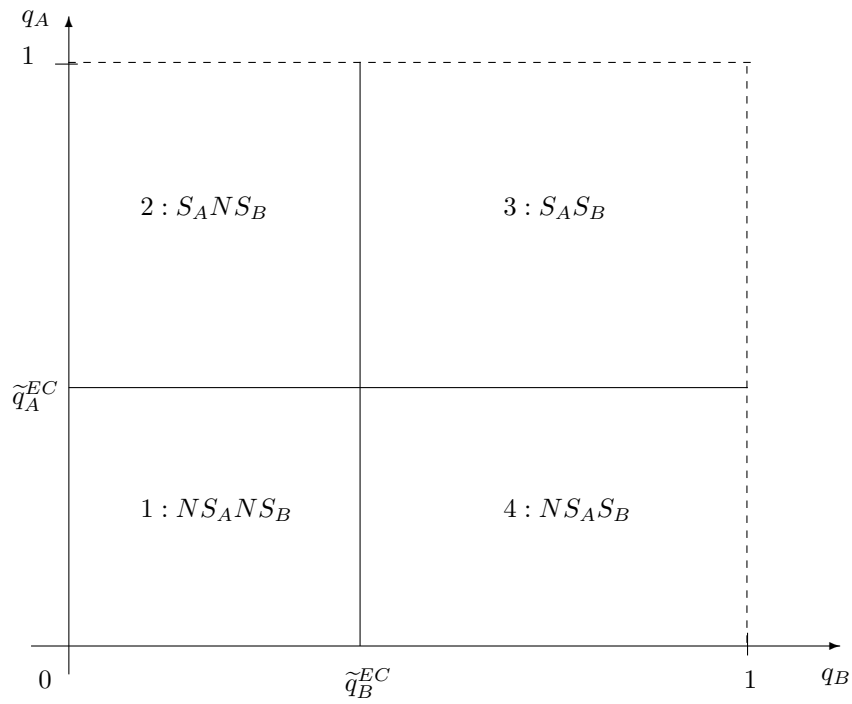


Figure 4: Stage 1 Reporting Decisions in the EC

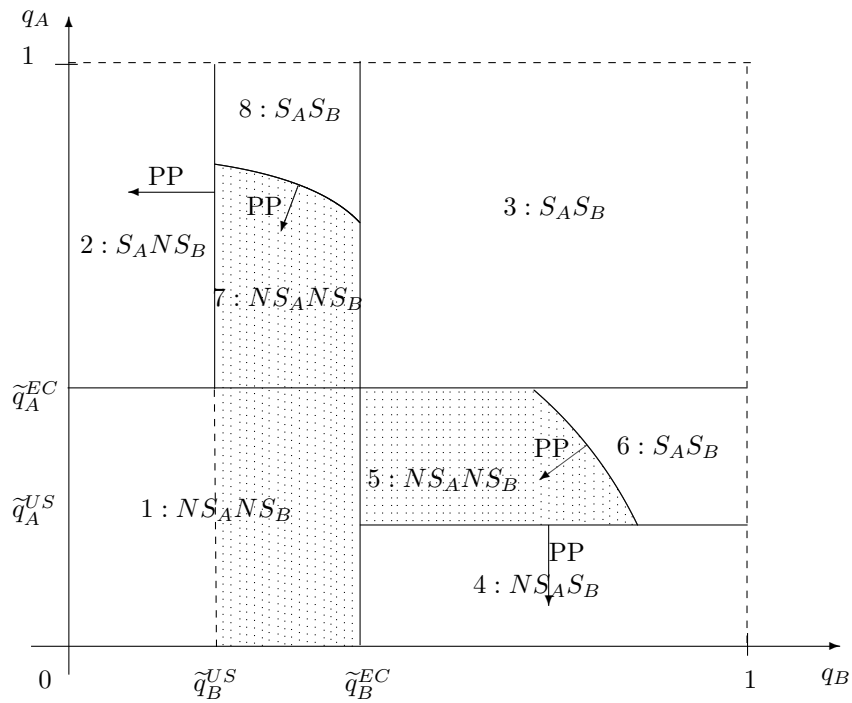


Figure 5: Stage 1 Reporting Decisions in the US



We identify four different regions common to the EC and the US system. In the US, however, there are four more areas which do not exist in the EU. Each region corresponds to a particular combination of revelation choices in stage 1 and stage 2. Hatched regions indicate that, if the game reaches stage 2, firms report cartel  $B$ .

**1. Not Reporting of  $A$  and  $B$ :**  $q_B < \tilde{q}_B^{EC}$  and  $q_A < \tilde{q}_A^{EC}$

Conviction probabilities fall below the EC thresholds, and expected cartel profits are positive in both markets. Thus, in the EC, conjectured investigation probabilities are too small to induce self-reporting. Firms neither report any of the cartels in stage 1, nor reconsider their decision to report the cartel in  $B$  in stage 2 after the AA has detected the cartel in  $A$ .

In the US, there are two different cases: First, assume the conviction probability in  $B$  falls between the US and the EC thresholds. Firms anticipate that after a conviction in market  $A$ , they report the cartel in  $B$ . As cartel profits in both markets are positive, however, firms have no incentives to report any of the cartels in stage 1. Second, assume that the conviction probability in  $B$  is lower than the US threshold. Then, even in the US, firms do not have any incentives to report the cartel in  $B$  after the detection of  $A$  in stage 1. Again, expected cartel profits are positive in both markets, and firms do not report any of the cartels in stage 1.

**2. Revelation of Only  $A$ :**  $q_B < \tilde{q}_B^{US}$  and  $q_A > \tilde{q}_A^{EC}$

The probability of conviction in  $A$  is above the EC threshold. The expected cartel profits in this market are negative. In the EU, firms report the cartel in  $A$  in stage 1. The reporting in  $A$  does not alter firms' whistle blowing incentives in  $B$ . As the probability of detection in  $B$  falls below the critical level in the US, self-reporting in  $A$  does not entail reporting in  $B$ . Thus, US firms only report the unprofitable cartel  $A$  in stage 1.

**3. Revelation of  $A$  and  $B$ :**  $q_B > \tilde{q}_B^{EC}$  and  $q_A > \tilde{q}_A^{EC}$

Conviction probabilities in both markets exceed the EC thresholds. Thus, firms do not find their cartels profitable on average. Consequently, in the EU as well as in the US, they report both cartels in stage 1. The AA convicts both cartels and grants amnesty to the first reporting firm. The other firm pays the full fine. The game does not reach stage 2.

**4. Revelation of Only  $B$ :**  $q_B > \tilde{q}_B^{EC}$  and  $q_A < \tilde{q}_A^{US}$

Firms find detection in market  $B$  likely enough to make expected cartel profits

negative, and thus, they would report the cartel in  $B$  in stage 1 under both policies. As the probability of detection in  $A$  falls below the critical level in the US, self-reporting in  $B$  does not entail reporting of the cartel in  $A$  in stage 2.

**5/6. Revelation of  $A$  and  $B$  or none:**  $q_B > \tilde{q}_B^{EC}$  and  $\tilde{q}_A^{US} < q_A < \tilde{q}_A^{EC}$

In the EU, region 4 accounts for this case. Firms report the cartel in  $B$  in stage 1. Regions 5 and 6 only exist in the US. Since the cartel in  $B$  gives negative expected profits, US firms would like to mimic firms in the EU and report the cartel in  $B$  in stage 1. Firms in the US know that reporting in  $B$  in stage 1 entails reporting of the cartel in  $A$  in stage 2. Cartel  $A$ , however, is profitable, and firms are reluctant to report it. Therefore, they choose between two strategies: Either firms simultaneously denounce both cartels in stage 1 to try to get in with the amnesty application before their partner does, knowing that the cartel in  $A$  would be at latest disclosed in stage 2, or firms not report at all in that stage. In the latter option, they would not report the cartel in  $B$  unless the AA discovered the cartel in  $A$  by its mere efforts. The maintenance of collusion in  $B$  may be, if not in market  $B$  taken individually, at least jointly beneficial because by the cooperation in  $B$  firms can sustain the cartel in  $A$ . To determine which of the two strategies firms would choose, we have locate the  $(q_A, q_B)$ -space where they find it profitable to switch from  $NS_A NS_B$  to  $S_A S_B$ <sup>9</sup>. If firms cooperate and not report any of the cartels in stage 1, two possible states can occur: First, with probability  $q_A$ , the AA discovers the profitable cartel in  $A$ , and firms rush to report the unprofitable cartel in  $B$  in order to save the fine in  $A$ <sup>10</sup>. Second, with probability  $1 - q_A$ , the AA does not find the cartel in  $A$ , stage 2 is not reached, and the cartel in  $B$  is detected with probability  $q_B$ . The expected profits from  $S_A S_B$  are higher than those from  $NS_A NS_B$  if

$$q_B > \frac{\Pi_A + \Pi_B}{\Pi_B + F_B} - \frac{1}{2} \frac{q_A}{(1 - q_A)} \frac{(F_A + F_B)}{(\Pi_B + F_B)} = \hat{q}_B$$

The above condition states that, if, for a given  $q_A$ , the AA is likely to detect the cartel in  $B$ , expected profits in this market are very negative, and firms find it too costly to sustain the cartel in  $B$  solely to preserve the cartel in  $A$ . This is what happens in region 6. There, Amnesty Plus has a desirable effect: Firms report both cartels in stage 1 instead of only one cartel as this would be the case in the

<sup>9</sup>The best possible deviation from  $NS_A NS_B$  is  $S_A S_B$ . From a deviation to  $NS_A S_B$  the deviating firm get  $2\Pi_N - \frac{1}{2}F_A < 2\Pi_N$  because reporting in  $A$  entails reporting of  $B$  in stage 2 and the other firms would simultaneously apply for amnesty in stage 2. A deviation to  $S_A NS_B$  is clearly not optimal because this means reporting the profitable market and keeping the unprofitable one.

<sup>10</sup>Then each of the firms can get Amnesty Plus with 50% chance and thus pays no fine resp. both fines in 50% of the cases.

EU. Moreover,  $\hat{q}_B$  decreases and is concave in  $q_A$  which indicates that, the higher the probability the AA detects the cartel in  $A$  by its mere efforts, the lower the probability of detection needed in  $B$  in order to induce reporting of both cartels in stage 1. On the contrary, if the conviction probability in  $B$  is too low, i.e.  $q_B \leq \hat{q}_B$ , Amnesty Plus is detrimental since it invigorates collusion in both markets whereas at least one cartel would have been reported under the EC Leniency Program. This situation corresponds to region 5.

**7/8. Revelation of  $A$  and  $B$  or none:**  $\tilde{q}_B^{US} < q_B < \tilde{q}_B^{EC}$  and  $q_A > \tilde{q}_A^{EC}$

In the EU, this case falls in region 2. Regions 7 and 8 do not exist. In market  $A$ , conviction is sufficiently likely to make expected cartel profits negative. As a consequence, firms would like to report the cartel in  $A$  while preserving positive expected cartel profits in  $B$ . In the US, however, firms anticipate that, if they report the cartel in  $A$  in stage 1, they will have to sacrifice their cartel profits in  $B$  in stage 2. Therefore, firms' optimal strategy would be either to immediately disclose both cartels or not to report at all. By keeping secret the cartel in  $A$  firms are able to sustain the cartel in  $B$ . Firms deviate from  $NS_A NS_B$  to  $S_A S_B$  if their expected profits from the latter option are higher. The condition is the same as above and thus, if  $q_B \leq \hat{q}_B$ , firms play  $NS_A NS_B$  rather than  $S_A S_B$  in stage 1. This corresponds to regions 7 and 8 respectively.

## 6 Penalty Plus

To account for Penalty Plus in the US setting, we increase the fine to  $(1 + \alpha)F_i$  for  $i = A, B$ . This harshly punishes firms which do not report in stage 2 after a cartel conviction in stage 1. Thereby, Penalty Plus decreases expected profits from cartel behavior in stage 2 and amplifies the beneficial effect of Amnesty Plus in this stage. The fear of harsher fines further lower the probability threshold above which the  $(S, S)$  outcome is a NE. Figure 6 shows the thresholds after the inclusion of Penalty Plus and compares the situation to the the EC and the US with only Amnesty Plus.

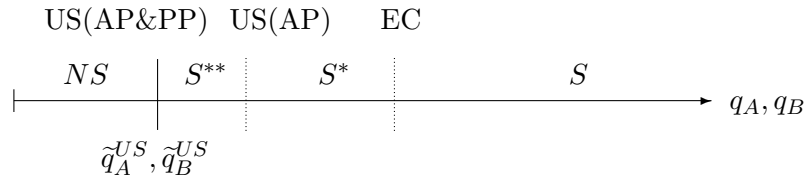


Figure 6: Stage 2 Reporting Decisions in the US, Amnesty Plus and Penalty Plus

Penalty Plus enlarges the probability range for which firms report the second infringement in stage 2 by  $S^{**}$  at the expense of the zone where  $(NS, NS)$  is the NE. Arrows indicate this shift in Figure 5. To compute the relevant thresholds, we proceed as in section 4. We find that the critical probabilities decrease to  $\frac{\Pi_B - F_A}{\Pi_B + (1 + \alpha)F_B} = \hat{q}_B^{US}$  and  $\frac{\Pi_A - F_B}{\Pi_A + (1 + \alpha)F_A} = \hat{q}_A^{US}$  after a conviction in market  $A$  and  $B$  respectively. Penalty Plus also has a direct impact on firms' revelation incentives in stage 1 by increasing the expected fines when firms decide not to report at all. If the AA detects the cartel in  $A$ , firms would simultaneously apply for Amnesty Plus in market  $B$ . Each firm has a 50% chance to get the plus in  $A$  and amnesty in  $B$ . The latecomer pays a higher fine under Penalty Plus. Thus, the threshold above which firms report both cartels already in stage 1 decreases to

$$\hat{q}_B = \frac{\Pi_A + \Pi_B}{\Pi_B + F_B} - \frac{1}{2} \frac{q_A}{(1 - q_A)} \frac{(F_A + (1 + \alpha)F_B)}{(\Pi_B + F_B)}$$

In Figure 5, arrows suggest this downward shift.

## 7 Conclusion

This paper has examined the effect of Amnesty Plus and Penalty Plus on the incentives for companies, simultaneously engaged in multiple cartel activities, to reveal the whole extent of their antitrust offenses.

Analyzing the interaction between two firms, simultaneously engaged in cartel activities in markets  $A$  and  $B$ , and the AA, our results have confirmed the intuition that Amnesty Plus and Penalty Plus enhance firms' incentives to report a cartel once they have been convicted for another illegal cartel agreement. However, we have shown that Amnesty Plus and Penalty Plus have an ambiguous impact on firms' incentives to apply for amnesty in the first place. On the one hand, firms, anticipating their rival's action in stage 2, are less willing to denounce a cartel, otherwise reported under the EC policy, if this would entail revelation of the second cartel. Thus, Amnesty Plus and Penalty Plus may help to sustain collusion in both markets, especially if the second cartel gives firms high expected profits. On the other hand, Amnesty Plus and Penalty Plus may lead to immediate self-reporting in both markets. This is because firms, fearing that, after reporting one, their partner reveals the other cartel, would prefer to immediately report both cartels. This desirable effect occurs if expected cartel profits in one market are not sufficient to compensate for forgoing leniency in the other market. Which of the effects prevails depends on the AA's enforcement policy.

Our analysis stresses an essential issue in leniency policy. Further research has to be done to embed this model in a dynamic framework taking into account the ongoing nature of the relationship between cartel members. Moreover, having understood the impact of the strategic linkages between markets generated by Amnesty Plus and Penalty Plus on firms' decisions in the revelation stage of the game, the effect on cartel formation remains to be explored.

## References

- [1] Aubert C., Kovacic W. and Rey P. (2003): *The Impact of Leniency Programs on Cartels*, forthcoming in the International Journal of Industrial Organization.
- [2] Barboza D. (10 October 1999): *A Tearing Down the Façade of ‘Vitamins Inc.’*, New York Times, Section 3, pp.1.
- [3] Bernheim B. D. and Whinston M. D. (1990): *Multimarket Contact and Collusive Behavior*, The RAND Journal of Economics, Vol.21, No.1, pp.1-26.
- [4] Connor J. M. (2003): *International Price Fixing: Resurgence and Deterrence*, Purdue University, mimeo.
- [5] Connor J. M. (2000): *Archer Daniels Midland: Price-Fixer to the World*, Purdue University, Department of Agricultural Economics, mimeo.
- [6] EC: *Press Releases*.  
Available at: <http://europa.eu.int/rapid/>
- [7] EC (19 February 2002): *Commission notice on immunity from fines and reduction of fines in cartel cases*, 2002/C 45/03.  
Available at: <http://europa.eu.int/comm/competition/antitrust/leniency/>
- [8] Edwards C. D. (1955): *Conglomerate Bigness as a Source of Power*, In Business Concentration and Proce Policy, NBER conference report, Princeton: Princeton University Press.
- [9] Feess E. and Walzl M. (2004): *An Analysis of Corporate Leniency Programs and Lessons to Learn for US and EU Policies*, Research Memoranda 039, METEOR, Maastricht Research School of Economics of Technology and Organization.
- [10] Hammond S. D. (2006): *Measuring the Value of Second-In Cooperation in Corporate Plea Negotiations*, The 54th Annual American Bar Association Section of Antitrust Law Spring Meeting, March 29, 2006.
- [11] Hammond S. D. (2004): *Cornerstones of an Effective Leniency Program*, presented at the ICN Workshop on Leniency Programs, Sydney, November 22-23, 2004.
- [12] Hammond S. D. (2000): *Fighting Cartels - Why and How? Lessons Common to Detecting and Deterring Cartel Activity*, presented at the 3rd Nordic Competition Policy Conference, Stockholm, September 12, 2000.

- [13] Harrington J. E. (2005): *Optimal Corporate Leniency Programs*, mimeo, Department of Economics, John Hopkins University.
- [14] Harrington J. E. (1987): *Collusion in Multiproduct Oligopoly Games under a Finite Horizon*, International Economic Review, Vol.28, No.1, pp.1-14.
- [15] Hinloopen J. (2002): *The Effectiveness of Leniency Programs under European Style Antitrust Legislation*, mimeo, University of Amsterdam.
- [16] Jarrett Arp D. and Spratling G. R. (2003). *A new paradigm for counsel responding to international cartel investigation*, Global Competition Review, No.6, pp.28-33.
- [17] Jephcott (2002): *The European Commission's New Leniency Notice - Whistling the Right Tune*, European Competition Law Review, Vol.23, No.8, pp.378-385.
- [18] McElwee D. (2004): *Should the European Commission Adopt 'Amnesty Plus' in its Fight Against Hard-Core Cartels?*, European Competition Law Review, Vol.25, No.9, pp.558-565.
- [19] Motchenkova E. and van der Laan R. (2005): *Strictness of Leniency Programs and Cartels of Asymmetric Firms*, Discussion Paper, Tilburg University, CentER, No.74.
- [20] Motta M. and Polo M. (2003): *Leniency Programs and Cartel Prosecution*, International Journal of Industrial Organization, Vol.21, pp.347-379.
- [21] Spagnolo (2005): *Leniency and Whistleblowers in Antitrust*, presented at the C.E.P.R. Conference of "Competition Policy for International Development, Growth and Trade", Brussels, December 9-10, 2005, prepared for P. Buccirossi (Ed.), Handbook of Antitrust Economics, forthcoming in 2006 with M.I.T. Press.
- [22] Spagnolo G. (2003): *Divide et Impera: Optimal Deterrence Mechanisms Against Cartels and Organized Crime*, mimeo, C.E.P.R., University of Mannheim.
- [23] Spagnolo G. (2000): *Self-Defeating Antitrust Laws: How Leniency Programs Solve Bertrand's Paradox and Enforce Collusion in Auctions*, Fondazione Eni Enrico Mattei, Nota Di Lavoro 52.2000.
- [24] Spratling G. R. (1999): *Making Companies an Offer They Shouldn't Refuse*, The Antitrust Division's Corporate Leniency Policy - An Update, Department of Justice.
- [25] US DoJ (10 August 1993): *Corporate leniency policy*. Available at: <http://www.usdoj.gov/atr/public/guidelines/0091.htm>

## A Appendix: EC Leniency Program without Amnesty Plus

### A.1 No Revelation in Stage 1

$\downarrow F1, F2 \rightarrow$	S	NS
S	$2\Pi_N - F_A - \frac{1}{2}F_B$	$2\Pi_N - F_A$
	$2\Pi_N - F_A - \frac{1}{2}F_B$	$2\Pi_N - F_A - F_B$
NS	$2\Pi_N - F_A - F_B$	$\Pi_N - F_A + q_B(\Pi_N - F_B) + (1 - q_B)\Pi_B$
	$2\Pi_N - F_A$	$\Pi_N - F_A + q_B(\Pi_N - F_B) + (1 - q_B)\Pi_B$

Table 1: Stage 2 EC Revelation Game after  $(NS_A NS_B, NS_A NS_B)$  in Stage 1

### A.2 Revelation of A in Stage 1

$\downarrow F1, F2 \rightarrow$	S	NS
S	$2\Pi_N - F_A - \frac{1}{2}F_B$	$2\Pi_N - F_A$
	$2\Pi_N - \frac{1}{2}F_B$	$2\Pi_N - F_B$
NS	$2\Pi_N - F_A - F_B$	$\Pi_N - F_A + q_B(\Pi_N - F_B) + (1 - q_B)\Pi_B$
	$2\Pi_N$	$\Pi_N + q_B(\Pi_N - F_B) + (1 - q_B)\Pi_B$

Table 2: Stage 2 EC Revelation Game after  $(NS_A NS_B, S_A NS_B)$  in Stage 1

### A.3 Revelation of B in Stage 1

$\downarrow F1, F2 \rightarrow$	S	NS
S	$2\Pi_N - F_B - \frac{1}{2}F_A$	$2\Pi_N - F_B$
	$2\Pi_N - \frac{1}{2}F_A$	$2\Pi_N - F_A$
NS	$2\Pi_N - F_B - F_A$	$\Pi_N - F_B + q_A(\Pi_N - F_A) + (1 - q_A)\Pi_A$
	$2\Pi_N$	$\Pi_N + q_A(\Pi_N - F_A) + (1 - q_A)\Pi_A$

Table 3: Stage 2 EC Revelation Game after  $(NS_A NS_B, NS_A S_B)$  in Stage 1



## B Appendix: US Amnesty Program with Amnesty Plus

### B.1 No Revelation in Stage 1

$\downarrow$ F1, F2 $\rightarrow$	S	NS
S	$2\Pi_N - \frac{1}{2}(F_A + F_B)$	$2\Pi_N$
NS	$2\Pi_N - F_A - F_B$	$\Pi_N - F_A + q_B(\Pi_N - F_B) + (1 - q_B)\Pi_B$

Table 4: Stage 2 US Revelation Game after  $(NS_A NS_B, NS_A NS_B)$  in Stage 1

### B.2 Revelation of A in Stage 1

$\downarrow$ F1, F2 $\rightarrow$	S	NS
S	$2\Pi_N - \frac{1}{2}(F_A + F_B)$	$2\Pi_N$
NS	$2\Pi_N - F_B - F_A$	$\Pi_N - F_A + q_B(\Pi_N - F_B) + (1 - q_B)\Pi_B$

Table 5: Stage 2 US Revelation Game after  $(NS_A NS_B, S_A NS_B)$  in Stage 1

### B.3 Revelation of B in Stage 1

$\downarrow$ F1, F2 $\rightarrow$	S	NS
S	$2\Pi_N - \frac{1}{2}(F_A + F_B)$	$2\Pi_N$
NS	$2\Pi_N - F_B - F_A$	$\Pi_N - F_B + q_A(\Pi_N - F_A) + (1 - q_A)\Pi_A$

Table 6: Stage 2 US Revelation Game after  $(NS_A NS_B, NS_A S_B)$  in Stage 1

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