7 Leniency and Whistleblowers in Antitrust

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The last ten years have witnessed what one could call, with little or no exaggeration, a revolution in competition policy and antitrust enforcement, "the leniency revolution." Since the US Department of Justice's new leniency policies were introduced in 1993 (the *Corporate Leniency Policies*) and 1994 (the *Individual Leniency Policy*), and began displaying their effects, antitrust authorities' "normal way" to detect, prosecute, and hopefully also deter cartels appears to have radically changed. Buyers' complaints, audits, and dawn raids have been replaced by well-designed leniency policies and self-reporting cartel participants, only followed by the traditional methods.

Leniency policies, or programs, reduce sanctions against colluding firms that report information on their cartel to the Antitrust Authority and cooperate with it along the prosecution phase to help convict their former partners. The achievements of the new US leniency policies are described in a number of public speeches by the DOJ staff (available at http://www.usdoj.gov/atr/public/criminal.htm) and in several international reports (e.g., OECD 2002, 2003). Since their introduction, an unprecedented number of cartels has been detected and successfully prosecuted, much higher fines have been levied against participants, and several top executives from different countries have served jail sentences in the United States. This led the European Union and many other countries around the world to introduce analogous programs.[1]

This leniency revolution also led an increasing number of economists to look beyond the surface of the number of cartels detected or prosecuted and fines levied at how these programs work, what are their likely (positive and even negative) economic effects, and how they can be improved upon.

In this chapter, I review the recent evolution of leniency programs in the United States and the European Union, theoretical economic analyses of leniency programs, and the scarce empirical and experimental evidence available on the subject.[2] I then discuss recent proposals to reward the first cartel member or manager that reports "hard information" on an yet undetected cartel, and look briefly at the related experience of rewarding individuals that blow the whistle against corporations committing fraud against the US government (following the False Claim Act). I conclude with a list of desiderata for leniency

programs in antitrust, some suggestions how to improve current ones and eventually introduce whistleblower compensation schemes, and an agenda of open issues for future research. I make no pretense of being objective: having worked extensively on the subject, I have developed strong views on the crucial issues at stake, and my survey will reflect these views.

My discussion is also relevant to the fight of many other forms of multi-agent organized crime—corruption, auditor-manager collusion, and corporate crime in general—because these share with cartels the crucial features that well-designed leniency and whistleblower-reward programs exploit.[3] For simplicity, I write under the assumption that all cartels are bad for society and should ideally be deterred. However, it is important to keep in mind that there are situations where competition can harm consumers, for example, where non-contractible qualitative aspects are very important in terms of gains from trade. Then agreements to restraint competition may increase welfare.[4]

7.1 Important Preliminaries

7.1.1 What Is Special about Cartels and Analogous Forms of Organized Crime?

Cartels are a form of illegal activity involving the joint, coordinated effort of several agents aimed at restricting competition by fixing prices, allocating market shares, preventing entry, and so on. In this sense, cartels can be considered a mild form of *organized crime*.[5] As emphasized in Spagnolo (2000a, b), organized crimes like cartels share three fundamental features that make them very different from the standard isolated criminal act committed by an individual wrongdoer at the core of the modern economic literature on public law enforcement.[6]

- The first feature is that cooperation among several agents is required to perform the illegal activity, so problems of free-riding, holdup, moral hazard in teams, and opportunism in general become relevant: each individual wrongdoer could "run away with the money" and must be prevented from doing it. This "governance problem" cannot be solved in standard ways in illegal organizations because—to curb opportunism of its individual members and ensure internal cooperation—these cannot rely on explicit contracts enforced by the legal system, as do legal organizations. Stigler (1964) made forcefully this point for cartels, arguing that they are intrinsically unstable because of the individual cartel member's incentive to profit from "cheating" on the cartel, namely to undercut other cartel members by offering profitable and secret price cuts to their customers.
- The second important feature is that organized criminal activity typically takes the form of ongoing relationships: instead of isolated criminal acts with given benefit and harm, it delivers *flows* of present and expected future benefits and costs. This is, of course, a direct consequence of the first feature. Since free-riding and individual opportunism cannot be limited by explicit contracts enforced by the legal system, internal cohesion of the criminal organization must be ensured by the agents themselves, illegal arrangements must be "self-

enforcing.'' And the typical way to ensure this is long-term interaction, namely developing in time a reputation for being tough against who violates the agreement and/or establishing relational contracts sustained by the expectation of future gains from continued cooperation. In both cases a dynamic continued activity—''the shadow of the future''—is essential. Again, Stigler (1964) made this point implicitly for cartels, arguing that besides being profitable, to be feasible a cartel must, among other things, be able to police cartel members' compliance with the collusive agreement and credibly threaten to react to defections with analogous price cuts, so that these will not ''cheat,'' for fear of provoking a price war or other forms of retaliation.[7]

• The third, crucial feature, only noticed by economists in recent years, is that cooperating wrongdoers, by acting together, inevitably end up having—as a by-product—information on each others' misbehavior that could then in principle be reported to third parties, including law enforcers. This third feature is in turn a consequence of the first two, and is at the very hart of the effects of leniency programs. When crime is committed by a single agent, this will be very careful about being alone and unobserved, so that nobody can betray him but his own mistakes. With cartels and organized crime, instead, each wrongdoer must coordinate with and monitor the others, and automatically acquires information on the others' wrongdoing that can potentially be induced to reveal. How to extract this freely available information is the main issue in the optimal design of leniency programs and whistleblower schemes.

These three peculiar features imply complex dynamic incentive structures for the agents involved that are crucial to the optimal design of law enforcement policies. In particular, the fact that cartels are only feasible if participants are able to deter unilateral defections—like secret price cuts—by monitoring and threatening credible retaliation, introduces *a novel kind of deterrence*, not considered in the literature on law enforcement preceding recent dynamic analyses of antitrust enforcement and leniency programs, beginning with Cyrenne (1999) and Motta and Polo (2003). This condition, necessary for any cartel or illegal agreement because of the impossibility to use explicit contracts, is called ''incentive compatibility'' or ''self-enforcing'' constraint, in contrast to the ''participation'' constraint simply requiring that expected additional profits from entering a cartel net of expected antitrust consequences be positive.

Both participation and incentive constraints must necessarily be satisfied for a cartel to be viable so that if at least one of the two is violated, the cartel is deterred.[8] It turns out that it is much easier for law enforcers to ensure that the incentive constraint is violated than the participation one, in particular by using leniency and whistleblower programs. Many agree that these programs can increase deterrence by increasing the likelihood that cartels are convicted, but a crucial and often disregarded point is, in my view, that they can deter cartels with much lower expected sanctions than standard law enforcement. These programs may ensure that the self-enforcing constraint is not satisfied even when sanctions are still way below the level needed to make participation to the cartel unprofitable

in expectation, which is what static theories of public law enforcement would require for crime deterrence.[9]

Another crucial thing to note already at this stage is that this novel kind of deterrence is maximized when the incentive for an individual firm to unilaterally deviate and undercut the cartel are maximal, that is, when individual and collective interests of cartel members are most divergent. This means that the problem of maximizing cartel deterrence through leniency can be seen as the inverse of a public good contribution problem. Such an interpretation naturally suggests a "winner take all" approach that concentrates all benefits on one individual—the first one to self-report—maximizing the conflict of interest with the rest of the group/cartel.

7.1.2 Leniency Programs: "Nothing New under the Sky"?

Promises of lenient treatment or rewards to elements of an opponent front that "betray" their partners have always been used in warlike situations, and do not have a crystal clear reputation.[10] In law enforcement, offering captured wrongdoers a lenient treatment in exchange for information valuable to prosecution has been a standard tool for centuries practically everywhere.[11] In the United States, *plea bargains*, kind of postdetection exchanges of a lenient treatment against self-reporting have been taking place long before the introduction of leniency programs. Analogous postdetection exchanges during prosecution are still routinely used (and sometimes misused) in the United States and other countries to fight drug-dealing and other organized crime, even though no publicly announced leniency policy is present.[12] Public promises of prizes or leniency *before* detection and/or prosecution have also often been used in the past.[13] These promises, however, where typically decided case by case, crime by crime.

So what's new about leniency programs in antitrust?

In my view, the feature that makes the leniency programs in antitrust somewhat special, apart from the new field of law enforcement they are directed to, is their being ex ante, general, and public.

Leniency programs are ex ante because—in their first and most innovative parts—they are directed at wrongdoers that have not yet been identified/detected, encouraging these to self-report. Therefore leniency policies may act before detection and the prosecution stage, not only after detection occurred and prosecution began, as plea bargains.

Leniency programs are general in the sense that they apply anonymously to anyone who is in a certain codified situation and behaves or may think of potentially behaving in a certain way.

Leniency programs are public in the sense that even in the United States, where prosecutorial discretion has always allowed for exchanges of leniency against evidence, they take the form of codified, automatic (hence predictable), and publicly advertised policies.

Codification is actually instrumental to both generality and publicity. It helps reducing uncertainty and discretionality, two aspects that greatly discourage self-reports. Publicity is crucial for leniency programs because the crucial objectives of law enforcement are as follows:

1. Deterring (preventing) cartel formation by undermining trust among potential co-conspirators with the increased likelihood that one of them could then loose confidence and turn the others in;
2. Detecting (discovering) cartels that were not deterred, by eliciting information on and from them.

Both objectives require that the program be general, public, transparent, predictable, and well advertised in the legal and—above all—business community. This is perhaps one reason why DOJ officials are (and should) be spending so much time going around at business managers' and lawyers' meetings to present the results of these programs in terms of convicted cartels.

General, formalized, and anonymous policies promising leniency, protection, and sometimes rewards against collaboration to not-yet-detected individuals have recently and successfully been used in Italy to fight Sicilian Mafia and Red Brigades' terrorists. These public policies are probably the closest ever to the current leniency policies in antitrust, although their (successful) implementation, at least in Italy, has been much less careful than one would have hoped for.[14]

A third, important function of leniency programs in antitrust is ex post:

3. Facilitating prosecution through exchanges of a lenient treatment against information and/or testimony on the infringement *after* a cartel has been detected in other ways.

This function is particularly important in adversarial systems like the United States, where a jury must be persuaded rather than an administrative, trained body, because it is typically hard to find sufficient hard evidence on cartels to persuade a jury without direct witnesses. However, this function does not require the generality and publicity of a public Leniency Policy. Postdetection leniency/information exchanges can be done, and have always been done—with plea bargaining in Anglo-Saxon countries and Prisoner's Dilemma style promises in other systems—with direct, "private," tailor-made agreements between prosecutors and the specific individual wrongdoers. In this regard leniency programs appear therefore to bring less novelty to law enforcement. This view appears consistent with that of some practitioners involved with these programs. For example, according to the staff of the most experienced agency on the subject, the DOJ, the main issue about leniency programs is: "How do you build a leniency program that will cause a company to come forward and voluntarily report its participation in a cartel that has gone previously undetected?" (Hammond 2004, p. 2).

7.1.3 The Objectives of (Antitrust) Laws: What Is a "Success" in Law Enforcement?

Most antitrust practitioners, prosecutors and lawyers, and most casual observers have celebrated leniency programs as a terrific success. Can we be really sure that leniency programs are such a success? I believe they are effective, but we don't *know* it. To answer this simple question, which few have asked in the policy debate, we have to clarify what exactly is a success in antitrust law enforcement against cartels. To do this, we must go back to the objectives of antitrust laws. The discussion may appear redundant to many readers, but again my personal experience is that there is a lot of confusion around, in particular, between instruments and objectives, that makes an introductory discussion worthwhile.

As for most other laws, the main objective of antitrust law enforcement against cartels is avoiding that the outlawed courses of action—in our case collusive product market agreements—take place. There are, of course, other objectives, including victim compensation and justice/fairness per se. But these are clearly of second-order relevance: the main reason why societies invest large amounts of resources to enforce the law is to reduce the frequency of inefficient, outlawed courses of action, namely crime *deterrence* (Beccaria 1763, sec. XII).

With respect to cartels this general objective can take at least two forms:

- The first, and by far the most important objective, is *ex ante* or *general deterrence* (or just *deterrence* in the remainder of the chapter), that is, preventing cartel formation with the threat of sufficiently heavy and prompt expected sanctions against violators, and with other mechanisms that make cartels either unprofitable or unstable (on the dominance of prevention on any other target of law enforcement, see again Beccaria 1763 sec. XLI).
- A second, and secondary objective, is *ex post deterrence* or *desistance*, that is, ensuring that those among the cartels that could not be deterred ex ante, but are then detected and prosecuted by law enforcers, are induced to interrupt the illegal practice. This can be either by threat of even higher expected sanctions for repeat offenders, or by other, tougher mechanisms, like incapacitation through imprisonment or disqualification.

Ex ante deterrence is by far the most important because it can be achieved for a very large number of potential infringements and at a much lower social and individual cost than desistance.

Potential cartels that are not deterred will form, and then either go undetected, in which case they will directly reduce social welfare for the time of their existence, or be detected at some point by law enforcers. As they are prosecuted, the direct cost to society is reduced by the shorter life of the cartel (provided prosecution leads to desistance), though additional substantial social costs of prosecution are incurred.[15]

Potential cartels that law enforcement deter ex ante (prevents from forming) do not imply these social costs, nor does ex ante deterrence require that law enforcement agencies detect each particular potential violator, as is the case for desistance. Deterrence therefore acts *generally* on a much larger number of potential infringements. The more deterrence is

produced by a law enforcement system, the less desistance is needed and occurs. So society enjoys larger savings in prosecution costs.

For these reasons ex ante deterrence is, and must be the primary objective of law enforcement, and the foremost criterion for the evaluation of its optimality/efficiency.

Note that if we abstract from its effects on deterrence, prosecution is a pure deadweight loss to society. If prosecution had no deterrence effects, for example, because sanctions are too low (e.g., lower than gains from the infringement), from an economic efficiency point of view it should simply be avoided.[16]

The preceding discussion should have clarified that since law enforcement is a costly activity for society, the success of a (antitrust or other) law enforcement policy should be principally measured by the welfare increase from its *deterrence effects*, particularly ex ante ones, relative to its costs. A general problem therefore in evaluating the appropriateness and effectiveness of law enforcement policies is that it is hard (though not impossible) to estimate their deterrence effects. It requires identifying and measuring the costs of illegal acts that did not take place but that would have taken place in the absence of the law enforcement policy under scrutiny, and to compare them with the costs of the policy.

Going back to our leniency revolution, in the last decades we observed a steep increase in the number of successfully prosecuted cartels and in the size of imposed sanctions. This tells us something about the change in prosecution costs (they may have fallen, thanks to the improved information from leniency applicants, and their total may have increased together with the number of prosecuted infringements) but little about changes in deterrence. This is why we may well believe that in the United States the increase in convictions and prosecution costs should have fed up into increased deterrence, but clearly we don't *know* this.[17] One should keep in mind that in case of a "complete" success—complete prevention/deterrence—we would observe a *decrease* (to zero) in the number of detected and prosecuted infringements, not an increase.

To conclude, the optimistic view that the increase in convicted cartels reflects an increase in cartel deterrence is plausible, but the actual change in active cartels caused by the Corporate Leniency Policy is not directly observable. Therefore, in principle, the observed increase in convicted cartels could be due to an increase in cartel activity.[18] And even if we knew that current leniency programs increased cartel deterrence, we would not know whether differently designed ones would have done better. This calls loud for theoretical, experimental, and econometric research.

7.2 Evolution of Leniency Programs

In this section, I briefly discuss the evolution of leniency programs in the two world largest jurisdictions that introduced them, as they exemplify the two main legal frameworks within which antitrust law is being enforced around the world: an adversarial system, where juries and judges decide on the case since the first instance, and an administrative/

inquisitorial system, where a public agency has both prosecutorial and judicial power that is subject to appeal to higher courts.

7.2.1 The Evolution of US LPs

The DOJ introduced a first leniency policy for cartels already in 1978. This older policy was much less generous than the one introduced in 1993, both in terms of reductions in sanctions awarded to spontaneously reporting firms and the possibility to award leniency when firms under investigation start cooperating. The first program was not very transparent, not at all "automatic," leaving the DOJ with much discretion in its implementation, and prospective applicants with a lot of uncertainty on the likely outcome of a leniency application. As a result very few firms applied for leniency under the 1978 US leniency program.

The program revised in 1993 was also changed significantly, making the scope of amnesty much clearer and broader. In particular, Section A of the new Corporate Leniency Policy makes the awarding of complete amnesty to the first cartel member that self-reports *automatic* under the condition that no investigation is underway before the applicant comes forward. Its Section B awards leniency to the first reporting firm even when it reports after an investigation has begun, as long as at the time of the report the DOJ does not have already evidence "likely to result in a sustainable conviction." As long as reporting is a "truly corporate act," under the new policy amnesty is granted to all individual officers, directors, and employees of the applicant firm who cooperate with the investigation.

In addition the Individual Leniency Policy was introduced in 1994 to complement the corporate policy by offering individuals involved in a conspiracy the possibility to directly apply and receive amnesty independently of their company. However, the company and all fellow managers involved are not covered by leniency.

These revisions had a profound impact on the program. Since their introduction the number of applications increased more than tenfold and was accompanied by a dramatic increase in the magnitude of penalties imposed. Leniency applications appear directly responsible for successful prosecutions in several if not most recent high profile US cases. According to the OECD (2002, 2003), the dramatic increase in leniency applications is also due to the substantial increase in sanctions, both corporate and individual fines and jail sentences, that took place in recent years. But the two forces are likely to have operated together, reinforcing each other. The improved quality and quantity of evidence provided by leniency applicants are probably an important determinant of the DOJ's improved ability to obtain higher sanctions from US courts, and these higher and well-advertised sanctions in turn increased the attractiveness of leniency programs.

The combination of high sanctions and guaranteed amnesty for the first comer appears to have created strong incentives for corporations to come forward. According to Scott Hammond, former director of Criminal Enforcement of the DOJ Antitrust Division,

more than 50 percent of the leniency applications are taking place before an investigation is opened, falling therefore within Section A of the Corporate Leniency Policy (personal communication). In his words, "over the last five years, the Amnesty Program has been responsible for detecting and prosecuting more antitrust violation than all of our [other investigating tools]" (2001). Similar statements can be found in Spratling (1998, 1999).[19]

Even after the enormous increase in convictions and fines of the last decade, concerns remained in the Antitrust Division and among commentators (e.g., Rey 2003; Spagnolo 2000a, 2004) that the prospect of treble-damage lawsuits was dissuading some antitrust wrongdoers from participating in the program. In particular, cartel participants had to weight the benefits of immunity from criminal prosecution against the likelihood of federal and state treble-damage claims based on their admitted wrongdoing. Leniency applicants might have found themselves liable not only for triple the damages suffered by customers that they dealt with but also for three times the damages of their co-conspirators' customers under joint and several liability rules.

Many of these concerns were removed by the 2004 Criminal Penalty Enhancement and Reform Act. This new legislation limits the total private civil liability of corporations that have entered into leniency agreements with the Antitrust Division (combined with that of their officers, directors, and employees who are covered by the agreement) to actual damages "attributable to the commerce done by the applicant in the goods or services affected by the violation" plus attorneys' fees, costs, and interest. That is, corporations that meet the requirements and obtain amnesty are no longer liable for treble but only single damages, and are no longer jointly and severally liable for damages suffered by their co-conspirators' customers. Conversely, the legislation increases the potential liability for cartel participants that do *not* obtain leniency, since in addition to their previous liability they may now also be jointly and severally liable for twice the actual damages suffered by customers of the leniency applicant. It also dramatically increases potential criminal penalties (much higher fines and up to ten years of jail) for price-fixing and analogous infringements.

7.2.2 Evolution of the EU LPs

The European Commission was among the first jurisdictions to follow the example of the DOJ, introducing a leniency program in 1996. As happened with the first US Leniency Policy, the first EU Leniency Notice was not very effective in eliciting reports from cartel members, as the amount of fine reduction was uncertain and discretional. Moreover fines had been low before 1996, and in the absence of criminal sanctions the incentive to come forward was rather low for corporations.

In February 2002 the Commission revised its six-year-old leniency program by reducing its discretion in its implementation and increasing the size of fine reductions leniency applicants could expect. The Commission also started to offer almost *automatic* immunity from fines to the first member of a cartel that reports valuable information before an

investigation is opened (Secs. 8a, 9) or when the EU has very little information (Secs. 8b, 10) on the cartel. Moreover the 2002 Leniency Notice substantially reduced the amount of information an applicant needs to report to obtain leniency when applying before an investigation is opened.

If a leniency application takes place before an investigation is open and falls under paragraphs 8a and 9 of the new Notice, then the amount of reported information required for leniency to be awarded must only be sufficient *to enable the Commission to carry out an investigation*. If, instead, the report takes place after the investigation started, falling under paragraphs 8b and 10 of the 2002 Notice, the requirement remains more stringent: the amount of reported information must be sufficient for the commission to *find an infringement*. Also the new EU Leniency Notice offers extended coverage. Ringleaders can now obtain leniency, provided they did not force other firms to join the cartel.

In the years following the February 2002 revision a clear "structural break" occurred in the path of reports, much like what happened in the United States after 1993, as something like a tenfold increase in the rate of application took place (Van Barlingen 2003). This trend intensified in the following years, with about half of the applications falling under paragraphs 8a and 9. This dramatic increase forced DG Competition to undertake an internal reorganization without which it would not have been able to handle all the cartel cases that are being reported. Meanwhile average EU fines also increased substantially, and likely further contributed to the strong increase in number of firms reporting to obtain leniency.

7.2.3 Main Differences

The US and EU leniency policies are often regarded as different in several respects. In my view, the two instruments are more similar than how often described, though they do differ in some respects and, most important, in how they are interpreted and implemented.

A first difference regards the treatment of ringleaders. Allowing also ringleaders to obtain leniency, as in the European Union but contrary to what is done in the United States, can (1) elicit self-reporting, as it may not be clear to a firm considering whether to apply for leniency if it risks being regarded as a ringleader, and (2) increase ex ante deterrence, since even the ringleader cannot be completely "trusted" not to lose confidence and rush to report under the leniency program. In contrast, in an adversarial system, where testimony is crucial to persuade juries, testimony by a ringleader may not be convincing. Such reasoning may be sufficient ground for the DOJ decision to exclude ringleaders from their winner-take-all leniency policy.[20]

A perhaps more critical difference is that the EU program offers milder forms of leniency also to all other firms that are not the first to come forward, provided that the additional information they report is sufficiently valuable to prove the case. The US program does not allow leniency to a second reporting firm; it only awards amnesty to the very first firm providing valuable information. Plea bargaining was practically eliminated from US

antitrust enforcement in 1989, so the DOJ does not have formal instruments left to reward a second or third firm that reports helpful information where sentences of wrongdoers do not qualify for leniency to judges and sentencing Guidelines.[21] However, even this difference is less sharp than appears on paper. The US courts have been given increasing discretion in setting sanctions, and can reduce them for firms that cooperate with investigators but do not qualify for amnesty.

It is sometimes argued that in the United States the first firm reporting information on a cartel automatically receives amnesty, whereas in the European Union whether a firm reporting after an investigation started receives leniency depends on the amount and novelty of the information reported (Section 10 of the EU Notice; as noted, the requirement of Section 9 for reports before an investigation started are milder). In my view, the two stated policies are not that different, though they may certainly be implemented in very different ways, since the US program places conditions on the information reported by an applicant.[22] If implemented strictly, these conditions limit the awarding of leniency to situations where the information provided is highly valuable, either because it reveals an unknown cartel or because the Division has very little such evidence against the firms it is investigating. This implicitly creates the link between the value of reported information and the awarding of leniency that is made explicit in the EU leniency program. Therefore, in principle, both programs can be implemented strictly, denying leniency—for example—when the reported information is not that valuable, to limit pro forma or strategic applications from firms withholding important information.

In my view, the most important statutory difference is that in the United States there is individual liability for cartel infringements and therefore a correspondent Individual Leniency Policy that complements the Corporate Policy. The ability of individual employees to obtain leniency on their own can generate agency problems in colluding firms and cause such firms to come forward more often, before a manager or employee decides to come forward on its own under the Individual Leniency Policy, or not to collude in the first place (see Sections 7.3.4 and 7.4.3 below).

7.3 Economic Theories of Leniency

From a theoretical viewpoint, the Prisoner's Dilemma game is perhaps the first and best-known model of a leniency/information exchange: the sanctions for a detected wrongdoer are reduced to induce him to confess and prove guilty his former partner(s). The Prisoner's Dilemma refers to a situation in which the joint law violators have already been detected, and leniency seeks to elicit additional information to facilitate prosecution, much like what happens in multilateral plea bargaining (e.g., Kobayashi 1992).

As argued before, the most novel and distinctive feature of leniency policies, not present in multilateral plea bargaining, is instead their potential ability to deter organized crime directly, rather than indirectly trough improved prosecution:

1. By preventing cartel formation with the increased likelihood that a leniency application will be their conclusion. That is, cartels are discouraged by "undermining trust" between wrongdoers with the increased risk that someone will unilaterally report to enjoy the benefit of leniency, which is typically restricted to the first reporting party.
2. By improving cartel detection by inducing undetected wrongdoers that lose confidence or interest in the cartel to spontaneously self-report and "turn in" their partners even when the law enforcement agency has no clue about the cartel.

Despite the prominence of the Prisoner's Dilemma game in economics and the importance of organized crime in society, until very recently there was no systematic economic investigation of the effects of leniency programs on long-term, dynamic forms of organized crime like cartels (or large-scale fraud, corruption, etc.).

The literature on law enforcement did analyze leniency and self-reporting, but relating to individual wrongdoers committing occasional crimes. For example, Kaplow and Shavell (1994) elegantly show how reducing sanctions against wrongdoers that spontaneously self-report lowers law enforcement costs by reducing the number of wrongdoers to be detected, and that when agents are risk averse, offering leniency to wrongdoers that self-report increases welfare by reducing the overall risk agents bear. Both these insights apply to leniency policies, in general. Malik (1993) discusses the role of self-reporting in reducing auditing costs in environmental regulation, while Innes (1999) discusses the value of the early remediation of damages that fine reductions for self-reporting wrongdoers allow for. Koffman and Lawarrée (1996) offer a first model how collusion in a hierarchy can be prevented by leniency: in a static principal–supervisor–agent model à la Tirole (1986), they propose to bring in a second supervisor and structure the two supervisors' incentives as a Prisoner's Dilemma. Then the second supervisor has incentive to report against the first supervisor just in case he entered a collusive agreement with the agent.

These papers highlight important benefits that lenient treatment of self-reporting wrongdoers can bring about, but they are static models, mostly of a single-agent crime, that cannot capture the new type of deterrence leniency brings in, the dynamic effects of leniency on cartels and other organized self-enforcing criminal relationships with the features discussed in section 7.1.1. Collusive agreements between price-fixing firms, like those between auditors and managers or CEOs and captured directors, are typically long-term, dynamic, and self-enforcing. Indeed a full understanding of dynamic phenomenon typically requires dynamic analysis.

The literature on plea bargaining is of course also strictly related to leniency programs, as it discusses the efficiency of exchanges of a lenient treatment against information/cooperation from wrongdoers, although taking place only after detection (e.g., Grossman and Katz 1983; Reinganum 1988). The closest paper in this literature is probably Kobayashi (1992), who presents a model with multiple heterogeneous and jointly liable defendants with different amounts of information on each others' wrongdoing. Kobayashi finds that it

may be optimal to award maximal leniency to the "worst" wrongdoer when this person has better information. As mentioned earlier, plea bargains are nevertheless exchanges of leniency against collaboration that only take place at the prosecution stage, meaning after wrongdoers have been already detected by other means. Therefore the plea bargains do not capture the most novel effects linked to leniency programs, which are the ex ante effects relative to wrongdoers that have not yet been detected.

In the remainder of this section, I will survey recent economic analyses of leniency programs in antitrust, focusing on contributions that I regard as illuminating. I will follow the timing with which the contribution were produced and circulated among researchers. At this point two things are worth noting:

1. As for most other forms of corporate crime, rational choice analysis is particularly well suited to analyze cartels and policies against them. The wrongdoers are well-educated, calculating firm managers, trained in evaluating costs and benefits of choices and to react to incentives, rather than to rage, passions, or instinct.[23]
2. The optimal design of leniency programs aims at destroying possibilities for illegal cooperation among competitors. It tends to destroy collusive equilibria in oligopolies and—ideally—leave only the competitive one. Because of this tendency to reduce/eliminate multiple equilibria, dynamic analyses of leniency are much less subject to the caveats imposed by the presence of many equilibria to other research fields based on dynamic game analyses.

7.3.1 Leniency Programs and Cartel Prosecution

The first, seminal paper explicitly dedicated to addressing the effects of leniency policies on cartels in an appropriately dynamic analytical framework is Motta and Polo (2003).[24] In this rich model, firms interact repeatedly in an oligopoly and choose whether or not to collude given the risk of being detected and prosecuted by an Antitrust Authority. If firms collude, they are subject to the risk of conviction; if they either do not collude or unilaterally defect from a collusive agreement, they are not. There is an exogenous budget of the Antitrust Authority that can be allocated to its two different tasks, detection and prosecution of detected cartels. A leniency program can be introduced that reduces fines against cartel members that provide information on the cartel, and that option may or may not be open to colluding firms that only begin collaborating after having been detected, during prosecution. Detection of a cartel by the Antitrust Authority leads to conviction only with some probability, and this probability is increased by leniency. Convicted cartels do not collude for some period of time, but they then slide back to collusion (previous versions used the alternative assumption that convicted firms would not again attempt collusion, with little change in results).

With its focus on prosecution this model takes on the spirit of plea bargaining literature. It is designed to answer a precise question: Should firms that report information when

being already under investigation be also eligible to some leniency? The main object of this study therefore is Section B of the Corporate Leniency Policy, relative to firms that cooperate with the Antitrust Authority only when they are already under investigation, which is similar to plea bargaining. Both the welfare effects in terms of ex ante deterrence and of ex post desistance are considered (this study is the first, to my knowledge to introduce this clarifying distinction).

The central result the model delivers is that although lenient treatment of cartel members already under prosecution in exchange for information and collaboration has a negative effect on deterrence by reducing overall sanctions against the cartel, it also tends to have a positive effect on deterrence by making prosecution faster/cheaper and more effective. This positive effect tends to dominate the first, negative effect on deterrence. Increasing the probability of being convicted if detected by making for the prosecution a stronger case frees resources from prosecution and reallocates them to improving cartel detection (the assumption is that the Antitrust Authority is benevolent and does not sit on the laurels of the increased number of successfully prosecuted cartels).

To obtain this central result, the model had to be simplified by the following assumptions:

1. Firms sustain collusive agreements with grim trigger strategies.
2. A defecting firm cannot be convicted for having been part of a cartel nor can it report on former partners.

Under these simplifying assumptions, however, cartel members report information only when they all agree to do so as part of the collusive strategy. So leniency programs appear unable to induce agents to spontaneously and noncooperatively self-report. This leads to three secondary, less intuitive conclusions of the Motta and Polo model:

1. To have any effect, a leniency program must be open to firms under investigation (a kind of "irrelevance result" for Section A of the US and Sections 8a–9 of the EU leniency programs).
2. The same lenient treatment should be offered to all firms that apply for leniency, independent of the order with which they report (under the two assumptions above removing the "first comer rule"—the benefit of being the first firm to report—has no cost).
3. Leniency programs are second-best. If the Antitrust Authority has sufficient resources to deter cartels through fines and inspections, it should not introduce leniency programs.[25]

7.3.2 Leniency Programs and Direct Deterrence

The three secondary conclusions of Motta and Polo (2003) are somewhat counterintuitive and contrast with the DOJ's statements on what are, in their view, the crucial features of an effective leniency program (e.g., see Hammond 2004). Also, because of the emphasis on postdetection prosecution that model was not open to important novel possibilities for

leniency programs different from their indirect effects of easier prosecution: the potential to *generally* and *directly* deter organized crime by (1) inducing undetected wrongdoers to spontaneously self-report and "turn in" their partners, and (2) preventing cartel formation by undermining trust among wrongdoers with the increased probability that one among them reports in order to benefit from the leniency program.

To highlight these direct effects in the simplest possible way Spagnolo (2000a) develops a stylized dynamic model of self-enforcing collusive/criminal agreements within a law enforcement system that brings Motta and Polo's (2003) approach closer to Becker (1968) and Kaplow and Shavell (1994), who focus on ex ante deterrence and spontaneous self-reporting rather than on postdetection leniency/information exchanges at the prosecution stage, albeit in static single-agent contexts. In regard to the three conclusions given above, Spagnolo (2000a) withdraws the possibility of leniency through reporting after having been detected and put under investigation, the object of Motta and Polo (2003). He focuses exclusively on the first sections of LPs, reserved only to firms that spontaneously report when their cartel has not been detected.

The first version of Spagnolo (2000a), directly building on Motta and Polo's work, inherits its assumption 2 that if a cartel member unilaterally defects undercutting the cartel price, he risks no more to be convicted for his past collusive activities. Because of this, the first version of the model delivered three main results:

1. Optimal leniency programs (their part on spontaneous reports before an investigation is opened) restrict maximum benefits to the first reporting party only.[26]
2. A program that rewards with a fines-financed bounty the first reporting firm could completely deter cartels at a finite level of fines without any prosecution or inspection costs. From the beginning the proposed reward is fine-financed, so that it does not weight on the public budget, and more important, in being (weakly) smaller than the sum of fines levied on other cartel members, *it cannot be exploited* by groups of individuals that take turn to report and cash the bonus.[27]
3. Leniency programs that only reduce/cancel fines have deterrence effect when repeat offenders are subject to higher expected sanctions. In that case a *protection from punishment* effect emerges because a firm that deviates from the cartel can soften the toughest two-phase punishment à la Abreu (1986). Firms can protect themselves by reporting the cartel under the leniency program when defecting: this reduces future expected cartel profits—the carrot that makes the stick credible—and therefore the maximal "toughness" of the punishment phase other firms can credibly threaten to impose.

Assumption 2 that a cartel member that unilaterally defects can no more be convicted is rather unrealistic and hides one of the most immediate effects of leniency leading to an "irrelevance results" analogous to Motta and Polo's result 1. Rey's (2003) rich survey also discussed this assumption and noted that it is often not realistic, hindering other possible effects. In extended versions of Spagnolo's model, circulating after (2001), assumption 2

was dropped. Allowing for a positive expected fine for a firm that defects by undercutting its cartel, Rey (2003) and Spagnolo (2004) clarified that the ''irrelevance result'' was fruit of that simplifying assumption and highlighted other possible deterrence effects of leniency policies, even without rewards. In particular, to results 1 through 3 above, Spagnolo (2004) added:

4. Absent leniency programs, law enforcing agencies should commit not to target agents that unilaterally defect from collusive strategies, and should make this policy public.[28]
5. Leniency programs that do not pay rewards but are restricted (or much more generous) with the first reporting party also deter cartel through a *protection from fines* effect. This effect is present as long as the reduced fines of the leniency program are below the expected fine of a defecting agent that does not report, an effect also discussed in Rey (2003). By increasing the expected payoff of an agent that defects and reports above that of an agent that just defects, the leniency program tightens individual firms' incentive constraint for colluding and destabilizes cartels.
6. Leniency programs that do not pay rewards may have a third direct deterrence effect by making illegal agreement more ''risky.'' As often stressed by DOJ officials, leniency can generate ''breakdowns in trust'' among wrongdoers. To capture this effect, *strategic risk* considerations (in the spirit of John Harsanyi and Reinhardt Selten's 1988 risk dominance concept) are introduced in the model. It is shown that moderate leniency programs always strictly increase the riskiness of entering/sticking to a given collusive agreement relative to abandoning it; the riskiness increases strictly more when eligibility to the program is restricted only to the first reporting party, as in the United States. This last finding offers direct support to DOJ officials' claim that the first-comer rule is crucial in generating breakdowns of trust in cartels and the consequent rushes to report.

Other studies shortly followed on the general direct deterrence effects of leniency programs for cartels members spontaneously self-reporting before an investigation is opened. Ellis and Wilson (2001) suggested an additional reason for cartel members to spontaneously apply to a leniency program before an investigation is opened. Within a dynamic oligopoly model, it shows that a leniency program can induce colluding firms to report information under the leniency program in order to damage competitors, meaning *to raise (future) rivals' costs* through fines and imprisonment of their management, thereby gaining a profitable strategic advantage in the following competitive phase. This incentive to use leniency to raise rivals' costs is anticipated by firms, and therefore adds to previously discussed direct effects in deterring cartel formation. Ellis and Wilson's model also indicates that leniency can have a stabilizing effect on cartels whose formation was not deterred; this negative effect will be further discussed later. Hinloopen (2003) considers a dynamic oligopoly model where probabilities of detection change over time. In this model, cartel deterrence increases with the generosity of the leniency program and with a higher probabilities of detection in any future period. Both Ellis and Wilson (2001) and Hinloopen

(2003) focus on two possible deviations from collusive strategies, the usual one of unilaterally undercutting the cartel and the novel one of self-reporting the agreement. In both models, however, the optimal unilateral defection appears to be unilaterally undercutting the cartel price (to increase profits) *and* reporting under the leniency program (to reduce the expected fine). It would be interesting to know which results would go through anyway and which would not by taking the optimal defection into account.[29]

7.3.3 Negative Side Effects of Leniency: Self-reporting as a *Threat*

Motta and Polo (2003) noted that by reducing sanctions for firms that cooperate at the prosecution stage, leniency programs have a negative effect on imposed fines. So deterrence is reduced, though this effect tends to be overcompensated by the positive effect of a higher probability of conviction. Economic analysis has identified other possible negative side effects of imperfectly designed leniency.

I mentioned that leniency makes self-reporting more attractive, and this may induce cartel members to defect and report. When self-reporting becomes attractive, the *threat* of self-reporting to punish an agent that did not behave as agreed upon by the cartel may also become credible. The threat to self-report in turn could be used by smart wrongdoers to enforce cartels that would not be sustainable in the absence of this law-induced threat. Such an issue did not arise in most models discussed until now because, simply put, the information cartel members generate and can report in each period is assumed to evaporate after one period.

Buccirossi and Spagnolo (2001, 2006) model this side effect of leniency on bilateral, sequential, and asymmetric illegal transactions, such as corruption or manager/auditor collusion. In this model an illegal action (a favor) is exchanged sequentially against a bribe, and the illegal partners can optimally choose both the level of the bribe and the timing of the transaction (who delivers first), after having observed the parameters of the law enforcement systems. The model shows that the ''moderate'' forms of leniency typically implemented in the real world can have the counterproductive side effect of facilitating occasional, and even some repeated, illegal transactions. The possibility to obtain a reduced sanction by self-reporting can be used as a credible threat to enforce otherwise unenforceable occasional (one-shot) illegal deals. The first party that performs can force the second party to comply and reciprocate by credibly threatening to report the crime in case of noncompliance. Even in corrupt relationships where transactions are frequently repeated, moderate leniency programs can increase the parties' ability to punish deviations, thereby stabilizing the illegal arrangements by reducing gains from defecting. In practice, the information that wrongdoers have on each other plays the role of a ''hostage'' that is used as a credible threat to govern the illegal exchange and punish failures to comply with the agreement. The model also shows that offering ''rewards'' to parties that blow the whistle destroys this counterproductive side effect of leniency by making the ''promise'' not to report no longer credible.

Spagnolo (2000b) studies this negative side effect with respect to cartels in oligopolistic industries and to bidding rings in multi-unit auction markets. He finds that when information on a collusive agreement is durable, a leniency program that reduces sanctions for agents that self-report can enforce collusive behavior in occasional (one-shot or infrequently repeated) multi-unit auctions, in particular, in procurement cases. Again, the leniency program has the side effect of conferring credibility to the threat to report the collusive agreement if a member of the ring undercuts it.

The model shows that this negative side effect applies to multi-unit auctions and it is strongly reinforced by current (EU and US) procurement regulation, which requires that if it turns out that bids were rigged, such as because the bid rigging agreement is reported under a leniency program, the outcome of the procurement auction is nullified and the auction is repeated. This rule is aimed at increasing the ability to monitor the awarding decisions and reduce the likelihood of corruption or favoritism, but it also guarantees that it is not profitable for a firm in a ring to undercut the bid-rigging agreement and simultaneously report under the leniency program. Then the auction must be re-run so that all gains from defection disappear. Spagnolo (2000b) also shows that the mechanism tends not apply to ''smooth deviation games,'' like standard oligopolies with many small buyers, since it requires a discontinuous payoff function—typical of multi-unit auctions but not of oligopolies with well-divisible demand. As a result a defecting party cannot smoothly fine-tune its defection and thus leave other cartel members lower but sufficient collusive rent that they prefer not to report after such partial defection.

Ellis and Wilson (2001) obtain a related effect in their model. Besides the potential incentive to report to raise rival costs mentioned in the previous section, their model shows that for cartels not deterred by this risk—and it turns out that these cartels are the most important to deter, those with worse social welfare consequences—the leniency program has the effect of stabilizing them. The reason is that if the cartel is formed, then leniency induces cartel members to self-report after any defection from agreed collusive strategies. The punishment for defection is thereby strengthened by an amount equal to antitrust fines, much like in the models just discussed.[30]

Brisset and Thomas (2004) analyze the effect of leniency programs on a ring's ability to exchange private cost information to organize a bidding ring in a first price sealed bid auction. Focusing on coordination while assuming enforcement, they find that also from a coordination point of view, a poorly designed ''low-powered'' leniency program does not have the desired deterrence effects while it can act as a threat that facilitates information exchanges among ring members. They show numerically that a program that rewards ring members reporting before an investigation is open does not have counterproductive effects; it increases deterrence by hindering a ring's ability to credibly exchange the private cost information necessary to form the ring.

Analogous counterproductive side effects of leniency emerge in several more recent models (Aubert et al. 2006; Motchenkova 2005; Harrington 2005; Chen and Harrigton

2007; Festerling 2005a), confirming and reinforcing this section's message that leniency policies must be designed and implemented with *extreme care*, as they may otherwise produce rather negative effects.

7.3.4 Leniency Programs and Rewards to Whistleblowers

The best-known result in Spagnolo (2000a, 2004) is probably that in a dynamic multi-agent version of a model à la Becker (1968) for organized crimes like cartels, the *first best* (complete deterrence without inspection/prosecution costs) can be achieved with high enough *finite* fines by promising the first wrongdoer that applies for leniency and self-reports a sufficiently high "fines-financed" reward (i.e., a reward smaller than the sum of fines levied on other co-conspirators). To my knowledge, this is the first law enforcement instrument that delivers the first best since Becker (1968), who showed that with standard instruments the first best cannot be achieved even with *infinite* fines, as with zero inspection costs/probability of detection even infinite fines have zero deterrence effect.[31]

Spagnolo's (2000a, 2004) models do not distinguish between colluding individuals and colluding organizations, as it is conceived to address optimal deterrence for many forms of organized crime besides cartels, most of which involve multiple collaborating individuals, but not multiple organizations. When colluding agents are organizations, as is the case for cartels, and rewards can be paid to individual employees of these organizations, a number of novel issues emerge.

Rewards to Individuals The model of Aubert, Kovacic, and Rey (2006) also focuses on the direct, general deterrence effects of leniency and rewards, and allows defecting firms to face the risk of conviction for past collusion. It greatly extends the approach to address novel issues linked to the effects of leniency and rewards offered to individual managers/employees on the internal organization of colluding and noncolluding firms. The model analyzes the costs and benefits of creating an agency problem between firms and their employees by allowing the latter to directly cash rewards when blowing the whistle and reporting their own firm's collusive behavior to the Antitrust Authority.

On the benefits side, the model shows that allowing employees of colluding firms that report information to obtain leniency and a cash reward increases the number of potential informants that a colluding firm must "bribe" to keep silent, directly increasing the cost of colluding and therefore the general deterrence effect of any given reward scheme. It also shows that rewards for individuals tend to be complementary to corporate leniency programs, as they make a colluding firm's strategy to defect, report, and stop "bribing" its own informed employees even more attractive, further destabilizing collusion.

On the cost side, they examine the main arguments put forward in the policy debate against offering (leniency and) rewards to individual employees that report a cartel, mainly based on the possible negative effects of this practice on firms' internal organization and performance.

These schemes may deter productive cooperation (e.g., welfare enhancing information-sharing on demand uncertainty) that could mistakenly be regarded as collusion by increasing the incentive to report it in the attempt to cash the reward. Aubert, Kovacic, and Rey show, however, that if mistakes are not too frequent, a reward scheme could, in principle, be built that only induces truthful reports.

Rewards for individuals can induce firms to inefficiently reduce turnover in order to minimize the number of parties informed about the collusive agreement. These authors' conclusion is that this inefficiency increases the cost of colluding but not of noncolluding firms. So rewards for self-reporting appear to have mostly positive cartel deterrence effects.

Colluding firms may be induced by schemes to adopt "innocent" attitudes, in particular, increasing investment in productivity enhancing technology, a type of investment that typically falls in cartelized industries. But these practices can have positive welfare effects because they induce colluding firms to be more efficient. Nevertheless, such schemes are costly, which makes collusion less attractive.

Aubert, Kovacic, and Rey offer several explanations for why firms continue keeping much "hard" information on their cartel at the risk of being detected by competition authorities. Among the explanations advanced and analyzed are that firms need information to persuade cartel partners that they did not "cheat" and undercut the agreement in situations of uncertainty and imperfect information. Such information is useful when a cartel breaks up because of an exogenous (e.g., productivity) shock.

Other Literature on Individual Whistleblowers The literature just discussed was the first to analyze rewards schemes in antitrust. Problems related to individual whistleblowers have been subject to economic analysis with respect to crimes other than those of cartels, mostly in relation to the US False Claim Act that rewards employees who reveal fraud to the federal government. Obviously all the literature cannot be surveyed here for lack of space. I will nevertheless offer a short overview of the issues involved.

First, there is an extensive sociological literature, typically about innocent employees discovering and reporting wrongdoing by their firms, internally or externally, without expecting any monetary reward for it. Glazer and Glazer (1991) and Alford (2002) provide some good case studies and include many references. The literature on such "pure" whistleblowers is rich, but the points of interest for us that it stresses are fundamentally two:

1. Whistleblowers experience (as documented) trouble finding work and a troubled social and private life after reporting. Potential employers throughout the industry, colleagues, friends, neighbors, and often even family members turn against them. So whistleblowers *must* be both rewarded and protected extremely well; otherwise, they will come forward only by mistake.[32]
2. Rewards for whistleblowers can lower morale in organizations, reducing trust, cooperation, and efficiency (e.g., Dwarkin and Near 1997).

There is a legal literature on whistleblower reward schemes. Two excellent examples are Howse and Daniels (1995) and Kovacic (2001). The former provides an informal law and economic analysis of the costs and benefits of rewarding whistleblowers under the False Claim Act, brilliantly examining the experience from multiple points of view, with a rather positive take on whistleblowing schemes.[33] The latter proposes to extends the experience to antitrust and discusses the legal issues that this may raise. Both cite many references on legal analyses for related subjects.

More or less formal economic analyses of whistleblowing in contexts different from antitrust take two forms. The first type deals with teams of colluding wrongdoers, typically employees of an organization. Among the contributors to this literature are Felli (1996), the already mentioned Koffman-Lawarree (1996), Leppamaki (1997), and Cooter and Garoupa (2000). Common to these analyses is the message of the Prisoner's Dilemma whereby rewards for whistleblowing can deter illegal cooperation. But they also adopt a static approach that does not endogenize how wrongdoers govern or enforce the illegal cooperation in the first place, and cannot capture the effects of rewarding whistleblowers' on self-enforcing relationships like cartels. Acemoglu (1997) is the first model I am aware of that considers whistleblowing while endogenizing self-enforcing collusion between a manager and an auditor. However, in this model whistleblowing (against improper managerial choices) is the statutory task of the auditor, hindered by manager–agent collusion, and is not seen as something to reward in order to hinder collusion on other dimensions.

The second type of economic analysis includes Tokar (2000) and Buccirossi et al. (2005). They focus on the conflicting objectives created between a firm and its employees when rewards schemes are available for individual whistleblowers, particularly when courts make mistakes and employees may find it convenient to "fabricate" information in the attempt to cash a reward. A more or less explicit conclusion of these papers is that high rewards for whistleblowers may require tougher sanctions against information fabrication to avoid negative effects on deterrence also in terms of courts choosing a higher standard of proof.

Two recent economic analyses of whistleblowing not fitting this classification are Heyes (2004) and Berentsen et al. (2005). Heyes models several kinds of intrinsic/behavioral motivations that can push employees to blow the whistle in the absence of rewards and incur high economic and social costs this implies without expecting any monetary benefit. Berentson et al. shows in an incomplete information framework how whistleblowers can deter forbidden "doping" equilibria in sport contests when competing agents do not collude but share private information on each other's behavior (on whether or not illegal means were used to obtain a competitive advantage in the contest).

Although interesting and closely related in spirit to the debate in antitrust, none of these analyses develop a dynamic model of self-enforcing collusion able to capture the trade-offs typical of a cartel and the novel kind of deterrence they lead to when coupled with leniency and whistleblower reward schemes.

7.3.5 Recent Developments

Equilibrium Reports The models focusing on direct deterrence effects discussed in sections 7.3.2 and in the subsection above keep the analysis simple by remaining in the tradition of complete information models of dynamic oligopoly (e.g., Friedman 1976; Abreu 1986, 1988). One cost of simplicity is that if one were to take these models literally, reports would be predicted only from cartels formed before an unanticipated leniency program was introduced, as a disequilibrium phenomenon. After that, since agents are forward-looking and there is no parameter uncertainty, either cartels form and are sustained, or they are deterred and do not form. In both cases no one spontaneously reports, just as in complete information oligopoly models in equilibrium punishments/price wars never occur. Nevertheless, the results of these models are clearly robust to the introduction of small stochastic shocks in various parameters (e.g., in the discount factor, or in the "disutility from sanctions") or simple forms of imperfect information (e.g., on the implementation of the leniency program). Either occurrence will generate equilibrium reports without changing much else. Richer models that obtain equilibrium reports in less obvious ways are helpful in verifying the robustness of early findings and possibly their novel effects.

A first analysis aimed at obtaining spontaneous equilibrium reports under a leniency program is Alexander and Cohen (2004). This is a static model of crime participation. It is different from the dynamic models discussed previously but close to Spagnolo (2000a, 2004) and Aubert et al. (2004) in its focus on general deterrence rather than desistance and prosecution. In this model gains from offending are ex ante uncertain, while the legal sanctions wrongdoers face if convicted—in addition to confiscation of illegal gains—are fixed, meaning the sanctions are not related to the realized profitability of the crime. The model shows, among other things, that ex post, wrongdoers whose realized criminal gains are low can be induced to spontaneously self-report to have their sanctions waived while giving up the (low) criminal gain. The contrary happens for wrongdoers whose realized criminal gains are high: they prefer not to report and face the risk of being caught and fully sanctioned to have the chance of keeping the high realized illegal gains. While the analysis is rich and elegant, and addresses several issues, the model is static and does not consider enforcement problems within a criminal team. So the results cannot be applied to cartels and similar forms of organized crime where firms/agents interact dynamically, face repeatedly both the choice of self-reporting and the risk of being discovered, and are subject to retaliation from competitors.

A more recent model that does take the dynamic features of cartels fully into account and obtains equilibrium reports, although only from colluding firms already under investigation, is Harrington (2005). It is a rich repeated oligopoly model that merges elements of several previous models and enriches them with a stochastically fluctuating continuous probability of successful prosecution after detection. The model is closest to Motta and Polo (2003), in that leniency is awarded to firms that report after their cartel has been

detected and an investigation has been opened (Sections B of the current US leniency program and paragraphs 8b and 10 of the EU one) namely at the prosecution stage. Also the focus is mainly on the ex post desistance effects of such reports and of the corporate leniency program in general, under the assumption that convicted cartels do not start colluding again. The model follows Rey (2003) and Spagnolo (2004) in allowing a defecting cartel member to face conviction for past collusion if caught. It therefore obtains the same "protection from fines" effect discussed in section 7.3.2 (re-named as Defector Amnesty Effect), together with the trade-off discussed in section 7.3.1 between the lower expected fines due to leniency obtained by reporting after having been detected (named Cartel Amnesty Effect) and the higher probability of conviction caused by the additional information obtained from firms' cooperating under the leniency program. A novel feature of this model is that when along the equilibrium path a cartel is put under investigation, firms may rush *noncooperatively* to report information under a sufficiently generous leniency program (an effect named Race to the Courthouse Effect).[34]

Equilibrium reports during prosecution, after colluding firms have been detected and an investigation has been opened, take place in this model when the realization of the probability of a successful conviction (and therefore of expected sanctions after the investigation started) is high.[35] When the realization of the probability of successful prosecution is low, it is equilibrium for detected firms not to collaborate and report even at the prosecution stage.

The model confirms that it is optimal to restrict amnesty to the first reporting agent. So in most cases maximal leniency is optimal (in terms of desistance). In other cases there may be a slight increase in leniency that is harmful. In general, it is optimal to award leniency only when the additional information it produces is sufficiently valuable in terms of its impact on the probability that the investigation ends with a successful conviction, as explicitly prescribed by the 2002 EU leniency program.

How Much Information?

Asymmetrically Informed Co-Conspirators For plea bargaining the first economic analysis of the role of asymmetries in self-reporting "team crimes" is the already mentioned one by Kobayashi (1992). In this model multiple defendants indicted for a jointly carried out organized crime face prosecution. The "most guilty" defendant, usually the ringleader, also has the most information about the criminal activity of the group, and therefore on that of other wrongdoers. The model shows that to maximize the probability of convicting the others and breaking apart the cartel, it is then optimal for the prosecutor to award the best deal exactly to the most culpable among the partner wrongdoers. Although the model is static and the focus is on postdetection prosecution, the intuition is rather strong and independent of dynamic incentive compatibility constraints. So the logic of the result is likely to extend to leniency and deterrence in dynamic frameworks, as suggested by Motta and Polo (2003, fn. 12). This policy implication is confirmed by Feess and Walz (2004b) who

explore the differences between the US and EC leniency program, among other things relative to the different minimum amount of revealed information necessary to obtain leniency. Feess and Walz derive a result with a flavor similar to Kobayashi's one but with respect to leniency and deterrence: it finds that a more informed party that self reports providing more information should indeed be allowed to receive more generous benefits under the leniency programs than a less informed reporting party. This model is static as well, so it evaluates deterrence in terms of violation of the participation constraint rather than violation of the more stringent incentive/self-enforcing constraints that any cartel must satisfy. However, the intuition behind the result is again linked to the impact of different informational endowments on the information revelation game induced by leniency, and therefore it might apply as well for dynamic multi-agent crimes like cartels.

A good reason why the force highlighted by these two papers might lead to different policy prescriptions in a dynamic environment that take properly into account cartel enforcement issues is that agents could anticipate and react to this, distorting the allocation of cartel shares so that the leader is also the one who gains more from a stable cartel and therefore loses more by self-reporting. The solidity of these conjectures in an appropriately dynamic framework, however, awaits future research.

Minimum Information Requirements DG Competition officials have have long suspected that some companies reporting a cartel under the new Leniency Notice had been strategically withholding information or made conflicting corporate statements. Because prosecuted applicants may face litigation and damages in this or other jurisdictions, they may perhaps be trying to obtain leniency and at the same time avoiding prosecution of the cartel.

Both the EU and US leniency programs explicitly condition immunity on open, complete, candid, and continued cooperation. The EU program even explicitly requires the reported information to be a substantial improvement in knowledge about the cartel for the DG Comp if the investigation started. These qualifications to the leniency policies can (and, in my view, should) be implemented strictly, since they are designed precisely to avoid strategic games of partial or distorted information revelation of the kind that took place in Italy when leniency programs were implemented against the Mafia and terrorism. Although these qualifications are there and, if properly implemented, should deter strategically limited or manipulated information reporting, DG Comp officials still appear to feel unable to fully prevent attempts to "game the system" by applying for leniency but reporting only a small part of available information or distorting it.

Harrington's (forthcoming) is the first model to analyze the critical issue of how valuable the reported information must be to make awarding amnesty worthwhile. The model allows for reports with different impacts on the likelihood of conviction. In most models discussed before, information reported is assumed to be "hard," that is, verifiable by third parties like judges, and enough in quantity and precision to lead to a conviction (i.e. it was implicitly assumed that "soft" information, like testimony not supported by documents,

pictures, or other tangible incriminating elements, would not be sufficient to give immunity). In Harrington's model also information is "hard" and, if reported, leads to sure conviction, but the probability that an open investigation ends up with a conviction is a continuous stochastic variable. When the realization of this probability is high, further information from reporting firms has little value. With low realizations instead, the additional information from reporting firms is highly valuable. Exploiting this source of variation, Harrington shows that to maximize desistance, leniency should only be awarded if it increases sufficiently the likelihood that prosecution ends up with a successful conviction. Otherwise, the negative effect on desistance of the Cartel Amnesty Effect could dominate other effects, and then leniency during prosecution would decrease desistance. This result supports a strict implementation of the explicit qualifications in the leniency programs about the minimum value of information and the candid, *complete* cooperation from the beginning required to award leniency. It also suggests that—to avoid strategically limited or distorted reports, Antitrust Agencies must always deny leniency when it is learned that an applicant withheld some information, and even consider it an important aggravating factor when setting sanctions. It would be useful, of course, if future research could look at the ex ante general deterrence effects of these requirements.

Prices, Timing, Asymmetries, and Other Issues

Leniency and Prices The deterrence effects of leniency programs of different generosities are modeled and numerically simulated in Chen and Harrington (2007). Chen and Harrington consider a dynamic homogeneous good Bertrand oligopoly model where the probability of being detected and convicted is endogenous and is a function of transaction price changes (with Bertrand competition the transaction price is the minimum among the quoted prices in each period). The sanctions include damages and are increasing in present and past realized profits. The model therefore brings together both the literature on leniency programs and on cartel pricing in the presence of an Antitrust Authority (e.g., Harrington 2004). Numerical simulations show that sufficiently generous leniency policies are beneficial in terms of direct deterrence, as they either deter cartel formation all together or reduce the optimal collusive price path of cartels that could not be deterred. This happens because they exacerbate the "protection from punishment" (or deviator amnesty) effect discussed in sections 7.3.2, 7.3.4, and 7.3.5. However, the simulations also show that intermediate levels of leniency (i.e., leniency that is not very generous) can end up stabilizing collusion, since it is then only used as a reaction after a defection takes place, as in the models discussed in section 7.3.3 with the consequence of contributing to punishing deviations and stabilizing the cartel.

Timing More specific timing issues are considered in Motchenkova (2004), whose dynamic model consists of a continuous-time two-firm preemption game to try capture better the time dimension of the "rush to report" idea so often stressed by DOJ officials. This

innovative approach shows, among other things, that limiting amnesty (the strongest fine reduction) only to the first firm applying for leniency is essential to induce such a "rush," and that less strict leniency programs that are also generous toward the firms reporting after the first can display negative side effects of the kind discussed in section 7.3.3. Although dynamic, to keep mathematical complexity under control, most of the analysis of this model does not take into account the incentive constraints that make cartels strategies self-enforcing and the novel kind of deterrence that leniency brings in through them. However, a final extension of the model does it, and the main results appear robust in this important respect.

Firm Size, Reputation, and Leniency Within a repeated duopoly model most close to Motta and Polo (2003), Motchenkova and van der Laan (2005) show that colluding firms that are heterogeneous in size and degree of diversification will react differently to the introduction of leniency programs if antitrust convictions have substantial negative reputational effects in terms of customer losses. Larger, more diversified firms are likely to be active in more markets than those in which they are colluding. If the reputational loss from an antitrust conviction in a market is substantial and spills over to other markets in which they are active, larger firms active in many markets will suffer larger reputational losses from conviction that cannot be reduced by leniency. Thus larger firms may then be, ceteris paribus, less prone to report their cartel under a leniency program but also to enter a cartel in the first place. Motchenkova and van der Laan also derive implications about the optimal "strictness" of the leniency program. They confirm that a larger difference in benefits awarded to the first and second firm reporting increases cartel deterrence.[36]

Individual versus Corporate Leniency The interaction between the individual leniency program and the corporate leniency program in the United States is the focus of a rich model by Festerling (2005a). Since the introduction of the corporate and then the individual leniency programs in the United States, there have been only applications to the former program. Aubert et al. (2005) already discussed complementarities between leniency offered to a firm and leniency plus rewards offered to its employees that report. Festerling, however, focuses on the case where managers fix prices contrary to their employers' wishes, and directly validates theoretically the DOJ's claim (see Hammond 2004) that the individual leniency program is effective despite no individual reports ever being observed. The main implied effect is that more corporate leniency applications result from threats of individual managers to self-report otherwise.[37] In this dynamic duopoly model, each firm is a hierarchy composed of a principal, firm owners, and an agent/manager with conflicting objectives regarding the legal consequences of antitrust convictions (e.g., exposure to private damage lawsuits, or limited ability to pay). The assumption is that the agent/manager chooses prices and whether to fix these prices with competitors without firm owners' consent. Nevertheless, when owners find out about a manager's misbehavior, they can report it to the Antitrust Authority. Corporate and individual sanctions and

leniency policies give rise to a multistage revelation game where either the firm owner or the agent/manager can report information about a cartel. The individual leniency program turns out never to be used, but its presence does generate in certain parameter configurations additional corporate leniency applications. In other parameters configurations, however, the possibility that the manager will report will "force" the owner to accept the cartel, which is a negative effect related to those discussed in section 7.3.3.

Optimal Fines, Imprisonment, Leniency, and Whistleblowers Leniency and whistleblowers schemes suggest the need for different kinds of sanctions. Buccirossi and Spagnolo (2007a) consider how the theory and practice of antitrust sanctions is, or at least should be, influenced by the presence of these schemes. They show that earlier simulations of the deterrence effects of fines ignore the different type of deterrence that leniency programs bring about, and therefore grossly overstate the minimum fine likely to have deterrence effects. With schemes that reward whistleblowers, the minimum fine with deterrence effects is shown to fall to extremely low levels (below 10 percent of the optimal "Beckerian" fine estimated before). With *well-designed and correctly implemented* schemes of this type, the implication is that problems of limited ability to pay and "judgment proofness" may lose their bite, and therefore that imprisonment may not be necessary to obtain sufficient deterrence. This contrasts with arguments many present without considering the potential of well-designed and implemented leniency and whistleblowers' reward schemes.

7.4 Empirical and Experimental Evidence

There is limited empirical and experimental evidence available on the effects of leniency programs in antitrust. In the following I discuss the three experimental studies and the two econometric analyses of leniency programs I am aware of. I then contribute a little to the empirical debate by informally examining what can be learned at this very early stage from the "natural experiments" of the changes in the design of leniency programs that took place respectively in 1993 in the United States and in 2002 in the European Union. The section ends with a short review of the recent experience of the US False Claim Act in terms of rewarding whistleblowers that help discover frauds against the US federal government with large bounties financed by recovered fines and damages.

7.4.1 Laboratory Experiments

The experimental method is highly indicated for analyses of leniency programs, particularly in terms of their otherwise unobservable general deterrence effects. Apesteguja, Dufwemberg and Selten (2006) take the first elegant step in this direction. They develop a stylized theoretical framework that attempts to capture the main points made in the recent literature on the direct effects of leniency policies on cartel deterrence, and they undertake an interesting experimental analysis of these effects. The market game analyzed is a one-shot homogeneous good Bertrand oligopoly with a discrete demand function embedded in

four legal frameworks: in the Ideal treatment there is no antitrust law at all, and communication across competitors (forming cartels) is not possible; in the Standard treatment convicted firms face fines equal to 10 percent of their revenue (and no fines at all if they have no revenue that period) and no reduction if they report; in the Leniency treatment firms that report a cartel they took part in receive a reduction in their fine; in the Bonus treatment reporting firms receive a percentage of the fines paid by other firms as a reward. Strategically equivalent collusive subgame perfect equilibria exist (in fact full folk theorems hold) in both the Standard and Leniency treatments, sustained by the threat of reporting if a defection takes place as in the models described in section 7.3.3. The experimental results confirm that agents understand and use the threat of reporting to sustain collusion, more in the Standard than in the Leniency type, and do not find that deterrence increases with the introduction of rewards.

The extremely stylized framework used in this first study, while adding to its elegance, opens a number of issues regarding the interpretation of its results. One issue is that the oligopoly game is not repeated, and that the experiment allows for only one round of decisions, leaving agents no way to learn the game, while the differences among Standard, Leniency, and Bonus treatments are not that easy to understand. It is therefore possible that some of the counterintuitive results, like that agents do not react to rewards, are driven by subjects not fully grasping the situation, as it happened to most early experiments on public good contribution, also not sufficiently often repeated.

A second issue is the somewhat unrealistic assumption that fines equal 10 percent of convicted firms' revenue in the relevant market and *zero* if these have in that period no revenue in such market. Together with the assumption of homogeneous good Bertrand competition, the low fines ensure that if a partner-cartelist "cheats" on the collusive agreement, reporting it is a "credible threat" (in the sense of section 7.3.3) already in the Standard treatment, even without leniency.[38] In the underlying model it is already implied that because of the absence of leniency in the Standard treatment, antitrust law enforcement has only the counterproductive function of enforcing collusion, which in this static framework would otherwise not be sustainable (as long as "cartel contracts" remain void). With this starting point the best scenario would be no antitrust law enforcement at all: declaring collusive agreements/contracts legally void may suffice to prevent any cartel formation, but the question would then be why not get rid of antitrust laws (and related costly enforcement agencies, lawyers and experts) all together, rather than playing around with counterproductive fines, leniency, and bonuses. In my reading, this first experiment strongly suggests that subjects understand how to use self-reporting as a "threat" to enforce collusion in occasional interactions, as discussed in models reviewed in Section 7.3.3. But this experiment is based on such particular and crucial assumptions that it is not easy to relate its results to the effectiveness of real world leniency or bonus schemes against long-term, hard-core cartels.

A second experimental study by Hamaguchi and Kawagoe (2005) considers the effects of cartel size and the restriction of amnesty to the first applicant on the likelihood that a

cartel is reported. The study finds the expected result that the larger is the cartel, the more effective is a given leniency program; and the less expected result that the effectiveness of a leniency program in inducing cartel members to self-report is not affected by whether only the first party or all parties that self-report are eligible to leniency. This experiment, however, does not capture the effect of leniency on cartel formation, meaning on general deterrence, since it first *forces* all the subjects to collude and then checks which cartels are reported.

A third recent experimental study that overcomes most drawbacks of the first two is that of Hinloopen and Soetevent (2005). In this study the underlying oligopoly game is repeated, communication is controlled for and allowed at different degrees; subjects are free to choose whether or not to agree on a collusive price. When leniency is introduced, cartel members can only report and obtain a fine discount before (knowing whether) an investigation is (will be) opened, and the first reporting party receives full amnesty, the second a 50 percent fine reduction, and the rest no fine reduction at all. This way the study addresses both direct general deterrence and desistance effects, but not the indirect effects linked to faster and cheaper prosecution nor rewards. The study uses Apesteguja et al.'s (2006) oligopoly model as a stage game of a repeated game with uncertain horizon, and adds to the legal framework a small fixed cost of reporting (1 point). This cost is present even when revenue is "zero" because competition is à la Bertrand and a cartel partner defected undercutting and stealing all customers from the others. Although small (an additional fixed cost/fine, limited to no-leniency treatments, would have further increased realism), this positive reporting cost partly captures the real world feature that—absent a leniency policy—if a cheated-upon cartel member reports, he is still subject to a fine. In this more realistic framework, incorporating the "protection from fines" (and in my view also part of the "increased riskiness") deterrence effect(s) discussed in section 7.3.2, this study confirms the potential of the positive ex ante deterrence effects linked to Sections A of the US Leniency Policy, restricted to the first "spontaneously" reporting party (the study does not consider rewards). It finds that with the introduction of a leniency program, on one hand, fewer cartels are established (i.e., a significant direct general ex ante deterrence effect of leniency programs restricted to firms reporting before an investigation is opened) and the life spans of cartels that were not deterred are reduced, but on the other hand, it also finds a constant high rate of "recidivism," in the sense that the same percentage of detected and convicted cartels starts colluding again after some time with and without leniency programs.

The lack of desistance effects implied by the recidivism is probably a consequence of the absence of higher fines or higher probability of detection for repeated offenders. That is to say, after a conviction, collusion is practically as attractive as before for the convicted cartel.

7.4.2 Econometric Studies

I am aware of only two econometric studies of the effects of leniency programs on cartels, both focusing on the 1996 version of the EU Leniency Program.

Brenner (2005) first analyzed econometrically the relationship between leniency applications, the size of actually imposed fines, and the duration of the investigation. Assuming that higher imposed fines signal, ceteris paribus, better information available to prosecution, Brenner finds that the program did help elicit information from cartel participants but not to the point of increasing deterrence (fines are higher in cases where some firms cooperated under the leniency program, but not much higher). No significant effects of leniency were found on the speed with which investigations were concluded nor on the hazard rate at which cartels break apart.

Arlman (2005) also analyzes econometrically the effects of the 1996 EC leniency program. In the 14 cases where leniency was awarded under the old program's section reserved to cases where the investigation was not yet open, Arlman finds 12 to have received a 100 percent fine reduction, one 90 percent, and one 80 percent. The remaining 140 firms received very partial leniency for collaborating during prosecution. The econometric analysis confirms that fines tend to be somewhat higher when leniency is used. But contrary to Brenner (2005), Arlman finds a significant effect of leniency on the speed with which a decision is taken by using the *maximal* amount of leniency awarded as explanatory variable rather than whether or not leniency was awarded. This result, contrasted with that of Brenner (2005), suggests that the speeding up of prosecution is linked to timely and substantial forms of reports under leniency, to which higher fine discounts are awarded, rather than to later and minor forms of cooperation more similar to plea bargains. Again contrary to Brenner (2005), Arlman finds that leniency does not provide prosecutors with better information. However, Arlman proxies available information with the number of words in the decision, and the interpretation of this variable in terms of better information is somewhat awkward.[39]

Both studies note that only five of the fourteen cases that obtained substantial leniency were really novel cases, the remaining being international cartels already detected and under prosecution (or already convicted) by the DOJ in the United States. This makes the judgment on the likely deterrence effects of the 1996 EU program rather conservative.[40] This is consistent with theoretical studies suggesting that to have a serious impact, a leniency program must be sufficiently transparent and generous; the 1996 EU program was criticized for leaving too much discretionality to the Commission. Since the incentive power of a leniency program directly depends on the severity of the sanctions a wrongdoer faces if caught because someone else reported, these studies confirm Buccirossi and Spagnolo's (2007a) evaluation that EU fines are likely to have been too low to have strong deterrence effects, even with current leniency programs.

7.4.3 Two Natural Experiments

As mentioned in section 7.2, the US and EU leniency programs changed over time. The main changes, in 1993 for the United States and 2002 for the European Union took place in discrete steps, and were not likely to have been fully anticipated by firms and lawyers.

So they can be regarded as kinds of "natural experiments." I also mentioned that according to informal communications of antitrust officials, the number of reports under the leniency program increased substantially after these changes. Here I explore these changes to obtain some preliminary and tentative indications on what features of a leniency program are likely to have a strong impact on the number of detected/reported cartels. However, these indications should be taken with due care, as they are based on nonverified aggregate information coming from informal communications and are drawn without controlling for other external changes that could have influenced firms' incentives to self-report. Further, as I explained in section 7.1.3, these indications have a rather far and uncertain connection with the likely deterrence effects of these programs, which is what ultimately matters.

The United States, 1993 Recall that in 1993 the US leniency program was changed dramatically, along the following dimensions:

1. *Increased generosity/transparency* The DOJ committed to award *automatic* full amnesty for the first applicant, providing information at early stages and making clear in advance the benefits of cooperation to the amnesty-seeker.
2. *Extended coverage I* Amnesty was made available to the first reporting party even after an investigation has been opened, provided that the DOJ did not already have evidence likely to result in a sustainable conviction.
3. *Extended coverage II* Amnesty obtained by the first reporting firm—if it reports as a true corporate act—was extended to cover all its directors, officers, and employees that collaborate.
4. *Positive rewards* Under the "Amnesty Plus" program, introduced a bit later, firms/managers convicted or under prosecution for one cartel for which they did not obtain immunity are invited to unveil other cartels they are or were involved with. If they reveal a new cartel, not only do they receive full amnesty with respect to this new cartel, they also get a substantial reduction in the sanctions/fines they would otherwise face for the first cartel, a net—though hidden—reward.

Before the 1993 changes, the DOJ received about one application for leniency per year. After 1993, it started receiving up to three applications per month on average, an obviously significant (more than tenfold) increase. Of all these post-1993 applications, more than half fell under Section A of the Corporate Leniency Policy, meaning they came in before an investigation was open, when the DOJ had either no or very little information on the cartel (personal communications, Scott Hammond and Gregory Werden, DOJ).

Tentative Conclusion It is not easy to distinguish among the relative contributions of the four changes listed above. All probably were relevant in determining the almost twentyfold increase in leniency applications after 1993. Yet clearly the more than half applications made before an investigation is opened should be linked to changes 1, 3, and/or 4.

The European Union, 2002 The main changes in the EU Leniency Program that took place in 2002 were as follows:

1. *Increase in generosity and transparency* Prospective applicants to the EU leniency program can now expect *automatic* full amnesty if they are the first to report information sufficiently useful to prosecutors before an investigation is opened.
2. *Extended coverage* Leniency is now also open to ringleaders, provided that they did not coerce other firms to join the cartel.

Both the 1996 and the 2002 EU leniency notices allowed firms to obtain partial fine-reductions when applying for leniency and reporting only after an investigation of their industry was already opened.

As mentioned earlier, in the first six years of the EU leniency program, between 1996 and 2002, only 16 applications for immunity were filed, of which just three led to the granting of immunity. In the three years following the 2002 changes, leniency applications and cases of immunity granted increased about tenfold: between February 2002 and June 2005 about 140 leniency applications were received, and about half of them fell under Sections 8a–9 of the Notice. That is, they took place before an investigation was opened, when DG Comp had little or no information on the cartel (personal communication, Bertus Van Barlingen, DG Comp).

Tentative Conclusion The numbers above appear to indicate that the most crucial part of a leniency program may be the one reserved to the first party reporting when the cartels is not yet under an investigation, which should be sufficiently generous and automatic.

7.4.4 Examples of Rewards to Whistleblowers

Spagnolo (2000a, 2004), Kovacic (2001), Rey (2003), Buccirossi and Spagnolo (2001, 2006), and Aubert et al. (2006) suggest that a carefully designed and implemented policy that rewards the first firm or agent that blows the whistle and turns in former partners can greatly increase cartel deterrence and simultaneously reduce the cost of antitrust law enforcement. Some observers have been highly skeptical about this possibly, suggesting that it is likely to bring in more costs than benefits, particularly in terms of false information fabricated and reported in order to cash rewards. In this section I briefly review three recent real world experiences with practices that reward whistleblowers.

Amnesty Plus in the United States In antitrust schemes that reward colluding firms/individuals that report information are already used with some success. As mentioned before, the DOJ is actively using rewards in exchange for information on new cartels on which it did not have information through its Amnesty Plus program directed at cartel members detected and successfully prosecuted (or under prosecution) that did not qualify for fine reductions under the leniency program. Amnesty Plus offers them, in case they re-

veal a second cartel they are or were involved with but about which the DOJ was not aware, a substantial reduction in the fine due for the first cartel for which they were convicted, besides full amnesty for the new one reported. The additional reduction in the fine for the first cartel can then be regarded as a net reward. According to DOJ officials, this is the most successful part of the US leniency program, and it is directly responsible for the detection of most unknown cartels (Hammond 2005).

Korea's Rewards Scheme Korea has been a front-runner in the introduction of rewards to individual whistleblowers, even more than for leniency programs, introduced in 1996 together with the European Union. In 2002, Korea openly introduced cash rewards—not hidden as reduced fines—for whistleblowers reporting information on cartels. The rewards, aimed at reinforcing the leniency program, much as discussed in Aubert et al. (2006), were initially very low (the ceiling was about US$20,000) and, not surprisingly, did not generate reports. In November 2003, the ceiling was increased (to about US$100,000), and until May 2005, it generated five reports. In May 2005, the ceiling to rewards was raised tenfold (to approximately US$1 million), and we will soon know how will economic agents react. I believe these maximal rewards are still too small to encourage whistleblowing, given the economic and social costs whistleblowers tend to face, which are probably higher in a small country with tightly knit economic and social networks like Korea. The sociological literature on whistleblowers (e.g., see section 7.3.4) makes it clear that individuals that blow the whistle face very harsh sanctions from their former business partners, peers, and the business community in general. The exclusion from future business and social relations, which may include physical harassment, may last for the several years during which prosecution takes place. Because of this, when directed at individuals, it is evident that only programs with very high expected rewards, like the US False Claim Act, are likely to be effective in inducing informed parties to spontaneously blow the whistle.

The US False Claim Act The most famous and successful program that rewards whistleblowers is probably the US False Claim Act against frauds to the federal government (the Sarbanes-Oxley Act appears to be catching up in fame but probably not in performance). It allows individual whistleblowers to file "qui tam" lawsuits against companies or individuals that committed fraud against the federal government, and to claim a fraction of fines and recovered funds.[41] In 1986 the False Claims Act was revised by Congress following reports of large-scale fraud against the government, especially by defense contractors. In order to give more incentives for whistleblowers to come forward and for private attorneys to use their own resources to investigate fraud, the False Claims Act was amended to include the provision of treble damages, mandating the defendant to pay a successful qui tam relator's his or her legal expenses, increasing the relator's share to 15 to 30 percent of total recovery, and protecting relators from retaliation.

Cases that can be filed as qui tam actions regard false claims that are either directly or indirectly presented to the government for "paying or approval." Along with a complaint the qui tam relator must file a "written disclosure of substantially all material evidence and information the person possesses." The DOJ can then choose whether or not it will join the whistleblower in the lawsuit. If the DOJ declines to join in a qui tam action, the relator has the right to investigate and prosecute the case. If the government does not join and the relator is successful in pursuing the case, the relator, generally, will receive a larger percentage of the award. The relator cannot receive the award if he or she is convicted for criminal infringements related to the fraud. So, to elicit information from parties involved in the fraud, immunity must be offered together with the possibility to file a qui tam lawsuit. Leniency and rewards are then complementary, much as discussed in Aubert et al. (2006).

The 1986 amendments to the False Claims Act have proved very effective in terms of generated government recovery. The scheme is now working in many other areas than defense, including prescription drug purchases, natural resource contracts, and low-income housing. Since 1987, the number of successful whistleblower lawsuits has increased continuously (see the instructive statistics at http://www.taf.org/statistics.htm). The highest level of recoveries yet was achieved in 2003, at about $1.5 billion, and was achieved at a comparatively low level of qui tam cases filed, 334, with total relators' awards of about $350 millions and *average* relator award above $1 million in over 20 percent of recoveries. This suggests that rewards for whistleblowers can reach very high levels without apparently causing strong negative side effects.[42]

Some observers have shown extreme skepticism about the proposal of offering rewards to whistleblowers in antitrust because of the possible increase in various types of legal enforcement costs these can bring about. As far as can be observed, the experience of the US False Claim Act does not support such extreme skepticism for well-designed and competently administered schemes.

7.5 Conclusions

In taking stock of the work discussed above, it can be safely concluded that a *well-designed* and *properly administered* leniency program appears to be an important and useful tool of antitrust law enforcement. It should be a tool that can *readily* be retrieved from the toolkit of an Antitrust Authority, independently of its budget. On the other hand, as in any incentive scheme, a poorly designed or administered leniency program can have serious counterproductive effects, some of which I have discussed here. In this concluding section, I will summarize the main features of what appears to be a well-designed leniency program in the light of current knowledge and discuss some issues that call for further research.

7.5.1 Characteristics of Well-designed Programs

Since the objective of a leniency program is deterring cartels by making them hard to sustain, a well-designed and implemented leniency program is one that makes the incentives of an individual (potential or real) cartel member as conflicting as possible with the interest of the cartel taken together. This means that a well-designed program must maximize incentives to betray the cartel by reporting important information to the Antitrust Authority, while at the same time limiting as much as possible the reduction in fines imposed on the whole cartel.

This objective can be achieved by maximizing the benefits an individual cartel member can receive from reporting under the leniency program, but restricting such maximal benefit to one and only one reporting party, the first comer. This extreme "winner take all" approach maximizes the conflict between individual and collective incentives in the cartel, and is likely to be the most crucial success factor in terms of deterrence.

Limited benefits in terms of partial reduced fines to parties reporting second may be useful to further increase the chances of winning the case, but they should be used only in extreme cases, when the information reported by the first reporting party, though useful, turns out insufficient to achieve a high probability of conviction by complementing it with all other ways to collect additional information that do not require further reductions in fines or other sanctions (dawn raids, records of further cartel activities obtained asking the first reporting party to go on "playing" the cartel member part, with a microphone and/or camera, etc.). The obvious reason is that although it may further facilitate prosecution, being lenient with more than one party tends to reduce both the total fines imposed on the cartel and the conflict between individual and collective incentives within the cartel, the two main sources of cartel deterrence. The aim of leniency programs is (at least should) not be making the job of prosecutors easier, but rather increasing cartel deterrence. So fine reductions for second or third reporting parties should be avoided unless it is clearly impossible to achieve conviction with the first report and more effort in traditional fact-finding strategies.

Well-designed and implemented leniency programs must be sufficiently generous with the first party that reports sufficiently important and possibly "hard" information. Otherwise, reporting can be used as a credible "threat" to enforce rather than to destabilize collusion. In this sense, protecting as much as possible the first and only the first reporting party from damage lawsuits is advisable, and I believe the US Congress should go all the way toward completely removing the possibility to obtain damages from a party that received amnesty under the leniency program. Conversely, requiring "restitution" of past collusive profits, as currently done by the US leniency program, is suboptimal from the deterrence perspective, and should be avoided.

Along the same lines, powering the leniency program with a well-designed and carefully implemented bounty scheme that rewards corporate and individual whistleblowing

appears feasible and worthwhile, as it is likely to improve cartel deterrence strongly at rather low cost. No major problem emerges from the empirical observation of the (well-designed and managed) US experiences with fraud, nor from economic and legal analyses of whistleblowers. Poorly designed or implemented schemes, on the other hand, are likely to produce negative effects of various types, as is the case for any other law enforcement instrument or incentive scheme.

Leniency should also be offered to the first party reporting after an investigation has already been opened, but if sanctions are sufficiently robust and the leniency and reward program sufficiently generous, the maximal reward should be restricted only to applicants that spontaneously report before an investigation is opened, when the Antitrust Authority has not yet knowledge about the cartel. The reason is that leniency awarded to parties reporting after an investigation has been opened, meaning after the existence of the cartel has been detected, has a real cost in terms of reduced deterrence linked to the lower expected fines for a cartel it may generate (it increases the attractiveness of the "wait and see" strategy of reporting only if the cartel is detected), and should therefore be less generous than for spontaneous reports of nondetected cartels.

As for any incentive scheme, the design and implementation of leniency and whistleblower reward programs must be transparent and predictable. Every observer should be able to easily assess how attractive it is for a firm or individual participating to a cartel to betray his partners, and thereby lose confidence from the beginning that a cartel can be stable and lead to sustained high profits rather than to a costly antitrust conviction.

7.5.2 Open Issues for Further Research

Many issues in need of further research have been discussed in the previous sections. Here I would like to underline those I regard as most urgent.

As I already stressed, more empirical and experimental evidence would be extremely welcome on all the aspects of leniency and whistleblower programs discussed in this chapter. In particular, researchers and the relevant competition authorities could collaborate in producing reliable *databases* and making them generally available for analysis. There are some issues, however, where more theoretical work is needed besides empirical analysis.

First, of course, is the *international dimension* of these programs and of antitrust law enforcement in general. It is obvious that if only a subset of countries where an antitrust policy is seriously implemented (i.e., with serious sanctions against infringements) introduces a well-designed leniency program, the effect on international cartels will be hindered by the threat to be sanctioned in the latter countries when applying for leniency in the former. This is why in the discussions around the *Empagram* case the European Union argued that allowing foreign victims to file civil damage claims in US courts against infringements in the EU member states will reduce the effectiveness of the EU leniency program, as this cannot protect applicants from the threat of such claims abroad. Clearly, when only a subset of countries uses serious sanctions to deter cartels, it may fail to deter international car-

tels when their gains from collusion are very large and proportional to their world market. This is why many observers argued in the *Empagram* discussion that foreign customers should be allowed to file damage claims in US courts against international cartels in order to compensate for the lack of sanctions in these and other countries (e.g., Bush et al. 2004).

An international "one-stop shop" where the first applicant reporting sufficient information becomes eligible for amnesty in all countries where a leniency program is present and the cartel was active, accompanied by a full protection from any damage lawsuits in any country for this applicant, is likely to be the best solution to solve the coordination problems. However, more formal analyses are needed on this issue.[43]

A second important subject in need of further research in my view is *the type and quantity of reported information and the risks of strategic manipulation of these programs*. So far most, if not all, theoretical work has focused on exchanges of leniency against "hard information," that is, against information difficult to falsify and easy to use as proof of the infringement. The most recent tendency in practice appears instead to accept more and more purely "oral statements," in order to encourage reports from cartel members that are afraid of facilitating lawsuits for damages following the cartel conviction if they were to report more "concrete" information. The obvious problem is that oral statements are harder to verify, and can open the door to falsifications or distortions, as has happened sometimes in Italy with the leniency programs against Mafia. And as I mentioned in section 7.3.5, some antitrust officials have the feeling that some companies coming forward and reporting a cartel could have been strategically withholding or distorting information, even though leniency programs explicitly condition immunity on open, complete, candid, and continued cooperation.

Of course, there may have been problems in the implementation of these rules. Nevertheless, the issue of how much and what type of information provided at the first and later stages by a leniency applicant should be sufficient to award immunity or rewards remains a delicate and unsettled one. On one hand, with high-powered incentives like rewards for whistleblowers one would think that a substantial amount of "hard evidence" should be required to minimize the risk of facing plenty of "reward-hunters" reporting insignificant or false/fabricated information. On the other hand, given the paucity of resources devoted to antitrust policy and the large number of industries and procurements to monitor, even very little, very "soft," but truthful information can be extremely helpful in terms of cartel deterrence. The simple but correct indication that there is a cartel in a given industry can lead to a successful dawn raid and to detection and conviction of an unknown cartel. How to be sure then that the first reporting party said it all? It could have judged it profitable to leak as few morsels as necessary to obtain the first place in the leniency line, and concealed or destroyed remaining evidence to reduce the probability of a real conviction.

Finally, a third issue I believe somewhat under-researched is the interplay between these programs, the inevitable *mistakes* in courts' decisions and the *standards of proof* chosen by courts at various levels. Elsewhere I have argued that courts are likely to increase the

standard of proof when facing information reported in exchange for a reward, but also that increasing sanctions against agents convicted for false reports is likely to have a deterrence effect on false reporting that may neutralize the first force. These effects depend in turn on the strength of the sanctions against each type of wrongdoing, and the outcome of this complex interaction may affect in subtle ways the optimal design of antitrust law enforcement policy against cartels.

Notes

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1. Those policies differ substantially across countries—for example, in their generosity and in their treatment of firms reporting second. They are formalized and can be downloaded in many languages from the homepages of the antitrust authorities that introduced them.

2. Rey (2003) offers a thorough discussion of the importance of implementation and enforcement issues in antitrust, with particular focus on cartel deterrence and leniency program (see also Motta 2004). This survey complements Rey (2003) by offering an update on the specific and fast growing literature on leniency and whistleblower reward programs, and on the evidence that has started to become available.

3. The debate on antitrust has been followed at short distance by a smaller, parallel debate on the treatment of whistleblowers in financial crimes, sparkled by the recent episodes of corporate mismanagement, from Enron to Parmalat, and by the consequent introduction of the Sarbane-Oxley Act in the United States. See, for example, Zingales (2004) and Friebel and Guriev (2005).

4. Lande (1983) discusses first examples of cartels whose social benefits counterbalance their social costs. Stiglitz (1989) notes that investments in high product quality supply backed by reputation are worth only if there are supracompetitive profits to win in the future. Fershtman and Pakes (2000), Kranton (2003), and Calzolari and Spagnolo (2005) present dynamic models where reducing competition by fixing prices can be beneficial for both producers and consumers.

5. This section may sound obvious and can perhaps be skipped by readers with a robust industrial organization and/or dynamic games background, or that have read Stigler (1964) with due care. The section is, however, crucial for other readers. My experience is that many economists (some top journal referees) brilliant in law and economics but without industrial organization background have a hard time understanding the crucial peculiarities of organized crime like cartels. So I take here the chance to discuss cartels as simply and clearly as possible.

6. This literature stems from Becker's (1968) seminal contribution. Polisnky and Shavell (2000) offer an elegant encompassing survey of this literature. See also Garoupa (1997), who, however, focuses mostly on why fines should not always be maximal.

7. This is why, as cartels, most organized crime *must* take the form of—or be conducted within—long-term dynamic criminal *relationships*. As we know since Schelling (1960) and Friedman (1971), only in a dynamic environment can there be reactions and threats, credible punishment against partners that defect, accounted for. See Polo (1995) for an economic analysis of internal cohesiveness and competition problems for criminal organizations.

8. In addition to these two constraints, there are a number of other conditions that must also be simultaneously satisfied for a cartel to be viable, including that the cartel is able to prevent entry, achieve coordination, and establish internal trust (in section 7.3.2, I discuss how leniency can deter cartels by reducing internal trust, increasing the perceived riskiness of such illegal collaboration).

9. Simulations in Buccirossi and Spagnolo (2007a) show that the minimal expected fines with deterrence effects in this case can be less that 10 percent the minimal "Beckerian" expected fines that violate the participation constraint.

10. The mot *Divide et impera*, of uncertain but ancient origin, describes Julius Cesar and other commanders' strategy of breaking coalitions of enemies by striking advantageous deals with one or few of them. Nazi occupants used rewards for "snitches" or a lenient treatment for them and their relatives to fight resistance in France and Italy. More recently Saddam Hussein and his sons and some Al Quaeda terrorists have been located by the same system.

11. The fact that leniency/information exchanges at the prosecution stage—namely after wrongdoers have been discovered—have been "standard practice" for centuries is also witnessed by how natural it appeared to Albert Tucker in 1950 to cast in terms of a Prisoner's Dilemma story the strategic situation studied by Merrill Flood and Melvin Dresher at the Rand Corporation in order to facilitate its understanding by a Stanford psychology class.

12. The misuse occurs when prosecutors and courts rely exclusively on a testimony obtained in exchange for leniency. A useful introduction to the drawbacks of this practice is at http://www.pbs.org/wgbh/pages/frontline/shows/snitch/. Throughout the chapter I will assume that the party applying for leniency must report "hard information" against his partners to obtain it, and that his testimony is only admitted when corroborated by "hard" pieces of evidence.

13. Schemes that reward whistleblowers with part of recovered funds have been used to reduce the cost of law enforcement since thirteen-century England. Bounties for "wanted" criminals have been common in many different countries and historical periods, and often did not distinguish between whether it was a gang member or an innocent witness (or a bounty killer) to turn in the wanted.

14. Obvious mistakes in the implementation of these programs—particularly in terms of letting applicants reveal information selectively, piece after piece, and in relying too much on them as witness rather than as sources of "hard information"—have led in Italy to their practical downfall despite their demonstrated effectiveness in the fight against Mafia and terrorism.

15. Prosecution costs include, among other things, the budgets of involved courts and agencies plus the cost of distortionary taxation required to finance them; the costs of prosecution/litigation not included in those budgets, like the cost of defence lawyers, expert witnesses, and the time loss of their clients; the social costs of type I errors in convictions of innocents; and the costs of imposing sanctions on (rightly or wrongly) convicted parties.

16. Again I am exaggerating a bit to clarify. Of course, there are other reasons to prosecute criminals, including pursuing "justice," which may directly produce utility in a society of justice-lovers, and offering compensation to victims. But the main motive is deterrence, and in case of cartels this objective appears even more critical.

17. Perhaps the strongest indication that US antitrust policy is having deterrence effects (and that the EU policy is not) is the observation that some recently uncovered international cartels chose to collude and meet in all markets around the world but the US market (see Hammond 2004).

18. This is a conclusion of the only two econometric analyses of leniency programs I am aware of, for the European Union between 1996 and 2002.

19. One must be careful to separate really spontaneous reports by members of yet undetected cartels from (a) reports when the DOJ is suspicious and may be about to start an investigation of the industry, e.g. because a cartel in that industry has been detected elsewhere, and (b) reports about a new cartel obtained by members of a detected cartel under prosecution asked whether they have anything else to report (the "omnibus question"). It would be useful if the DOJ and other Antitrust Authorities could help out by providing more precise data on this important issue.

20. I thank Gregory Werden for drawing my attention on this point. It would be nice to see these trade-offs analyzed formally.

21. Of course, the DOJ does have informal instruments to be lenient with a second cartel participant if it wishes to. As will become clear in the remainder of this chapter, I am in favor of the US stricter winner-take-all approach, with generous leniency and rewards but awarded only to the first applicant and only if enough information is reported (or collected ex post with a secret microphone/camera). Not least, reducing sanctions to several (possibly all) cartel members—as is possible in the European Union—besides reducing incentives to report first (wait and report only if somebody else does it first may become the optimal strategy for cartel members that would otherwise rush to report hoping not to arrive second or third with a winner-take-all program) tends to reduce total fines paid by the cartel. Both effects can substantially reduce deterrence, the very first objective of

antitrust law, and if the positive effect in terms of facilitating prosecution is not really dramatic (it may just consist in a easier life for the Antitrust Authorities' officials), such generosity can end up increasing prosecution costs (through the increased number of prosecuted cartels and staff required) while reducing general deterrence (by reducing expected sanctions), the worst that can happen.

22. The US program states that leniency can be awarded if either A) no investigation has been opened and "*1. At the time the corporation comes forward to report the illegal activity, the Division has not received information about the illegal activity being reported from any other source*;" or, independent of whether an investigation was opened, B) "*1. The corporation is the first one to come forward and qualify for leniency with respect to the illegal activity being reported*;" and "*2. The Division, at the time the corporation comes in, does not yet have evidence against the company that is likely to result in a sustainable conviction*." Moreover the US program requires that "*the corporation reports the wrongdoing with candor and completeness and provides full, continuing and complete cooperation to the Division throughout the investigation*." If it is discovered that some information was withheld by the reporting firm, leniency will not be awarded and the behavior of the reporting firm will be considered an aggravating factor (as in "Penalty Plus"; see Hammond 2004).

23. Recent experimental work has shown how agents often behave far from how a rational homo economicus might be expected to behave (e.g., see Camerer 2003). But if there is one field in law enforcement where rational choice models are likely to be useful to capture important features of the problem, this is the analysis of corporate crime, and in particular, of cartel deterrence. The pricing decision is typically a thought-over decision taken by skilled, strategic, forward-looking managers. While these agents can also make mistakes, they are obviously much less likely to make them regularly than less trained and calculating individuals.

24. The (1999) working paper version of this path-breaking paper is sufficiently different from the published version to be also worth reading.

25. This last conclusion is also due to the model's assumption that antitrust enforcement costs are exogenously given, do not enter social welfare, and cannot be traded off against higher fines or more effective leniency policies.

26. Allowing more agents to obtain leniency reduces deterrence by reducing the number of wrongdoers that must pay the full fine, without having any countervailing positive effects on detection and deterrence.

27. See Spagnolo (2000a, 2004) and Buccirossi and Spagnolo (2007a). The optimal policy, of course, also maximizes fines. High fines are now valuable not only because they reduce the expected value of collusive criminal relations, as in Becker (1968) but also because they allow offers of higher rewards to agents that self-report by both financing the reward and preventing agents to exploit it (again, only if the reward is larger than the fines it generates, agents could exploit the scheme by taking turns to report).

28. The reason is close to the logic of leniency: if agents know that they will not be fined for their past wrongdoing when they defect from the collusive agreement, they are more prone to do so, and this makes such agreements harder to sustain. The result is related to that of Cyrenne (1999). He finds that if Antitrust Authorities use price wars as signals of the presence of a cartel, they can end up stabilizing cartels *by increasing the strength of the punishment phases* (see also Harrington 2004). Relatedly, but differently, Spagnolo (2004) shows that by prosecuting firms that unilaterally defected from a cartel, Antitrust Authorities can end up stabilizing cartels *by reducing firms' expected gains from unilaterally defecting*.

29. A model by Fees and Walzl (2004a) also highlights the potential direct deterrence effects of a leniency program on multi-agent forms of crime like cartels. However, this model is static, and in the analysis the ability of the criminal team to cooperate/collude under different law enforcement regimes is assumed rather than derived. It is not clear therefore how its results can be interpreted relative to intrinsically dynamic and self-enforcing illegal relationships like cartels and most other forms of organized crime.

30. However, as mentioned before, with full immunity or with sufficiently generous fine reductions for the first comer the defection strategy of undercutting the cartel *and* reporting weakly dominates those of simply undercutting or reporting. It is unclear whether this result would survive taking the optimal defection into account.

31. The requirement that the reward paid to the first leniency applicant should not be larger than the sum of the fines paid by convicted cartel members is not an ad hoc budget-balancing constraint, as some have claimed. It is rather an endogenous constraint without which any reward system is doomed to fail in any real world situation akin to the model: absent other sanctions than fines, if the reward is larger than the sum of the fines it generates, there is the obvious risk that plenty of people will start building up fake or real cartels just in order to immediately denounce them, cash the reward, pay the fines, and keep and share the positive difference between the two.

32. According to Alford (2002), about half of all whistleblowers get fired, and many of them lose their homes, and then their families too.

33. See also Arlen's (1995) comment in the same volume. A more recent law and economics analysis of this issue is Depoorter and De Mot (2004); it formalizes a subset of the issues discussed by Howse and Daniels (1995).

34. Such rushes do not take place in Motta and Polo (2003) because in that model firms choose *cooperatively* whether or not to report when an investigation is opened. The possibility of such *noncooperative* rushes to report is the source of cartel deterrence in the models discussed in section 7.3.2 and 7.3.4, but such possibility never realizes along the equilibrium path because agents forecast it perfectly and in that case they do not start colluding in the first place.

35. This model therefore produces equilibrium reports from cartels already under an investigation, as in Motta and Polo (2003), but has no implications regarding equilibrium reports before detection, the focus of Spagnolo (2000a, 2004), Ellis and Wilson (2001), and Aubert et al. (2004).

36. The model is dynamic and evaluates the deterrence effects of leniency programs taking into account self-enforcement constraints. It seems to focus, however, on a specific set of strategies (Enter cartel and self-report; Enter cartel and not self-report; Not enter the cartel in the first place), and not to considering optimal defections for cartel members, which at the interim stage appears again to be Undercut the cartel *and* Self-report. It would be useful if the authors could extend their work to encompass optimal defections at all stages, or if future work would verify whether and how their results change with optimal defections.

37. In Hammond's words: "The real value and measure of the Individual Leniency Program is not in the number of individual applications we receive, but in the number of corporate applications it generates. It works because it acts as a watchdog to ensure that companies report the conduct themselves." (Hammond 2004, p. 12). On this issue, see also Mullin and Snyder (2005) and Buccirossi and Spagnolo (2007b).

38. The 10 percent of revenue rule was inspired by the EU cap of 10 percent of yearly revenue on antitrust fines. However, EU fines would never be zero in the absence of a leniency program. The 10 percent revenue cap for EU fines is relative to firms' overall yearly turnover in all lines of business and geographical markets, while the EU basic, minimum fine for horizontal cartels, independent of revenue, was for a long time 20 million euros. Moreover respect for the collusive price is considered *an aggravating factor* that increases the minimum fine. It is not easy to envisage a market where, if a firm undercuts the cartel, other firms in the cartel have zero revenue for one full year. Absent leniency policies, a firm with positive revenue that reports a cartel would be subject to a positive fine. The multiplicity of equilibria in Standard would then disappear as after a defection reporting is dominated by not doing it (and avoiding the fine), the outcome of Standard and Ideal would then most likely be similar and Leniency would fare much worse than how depicted, like predicted by models discussed in section 7.3.3.

39. It is at least debatable whether one needs more or fewer words to support a decision when better information is available. An inverse relation, more concise decisions when the evidence is very strong, appears at least as plausible as the one postulated in the study.

40. However, this does not automatically imply that the European Union was wrong in awarding full amnesty to overseas cartel members seeking amnesty in the European Union. In the absence of an international one-stop-shop for leniency, when one international cartel member first applies for leniency in the United States, and then later on in the European Union, the optimal thing to do for the European Union is to also award full leniency, even if it already had information on that cartel from the DOJ's investigation. Such a policy tends to encourage self-reporting in the United States, and therefore facilitates the detection of international cartels in general.

41. The words "qui tam" come from *Qui tam pro domino rege quam pro se ipso*, which means "he who brings an action on behalf of the king, as well as for himself." The organized use of whistleblowers in law enforcement in terms of qui tam seems to originate in thirteenth-century England, when, because of a lack of an organized police force, English common law adopted various qui tam provisions in order to enforce the king's laws. To make such actions attractive, a bounty was paid to the private party who enforced the law. The founders of the United States followed the English example and included qui tam provisions into most of the penal statutes enacted by the Continental Congress, America's first ruling body. On March 2, 1863, the False Claims Act, also known as the "Lincoln law," was passed by Congress at the urging of President Abraham Lincoln, following the report of widespread contractor fraud at the expenses of the Union Army. The law applied not only to military but to all government contractors.

42. In general, recoveries in cases declined by the DOJ fluctuate much more than those accepted and are also much lower, which implies that sustaining and winning a case without the government's support is very hard, and/or the screening activity of the DOJ is precise in selecting most important cases.

43. See Festerling (2005b) for a first step in this direction.

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