CHAPTER 4

Optimal Fines in the Era of Whistleblowers. Should Price Fixers still Go to Prison?

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Abstract

We review current methods for calculating fines against cartels in the US and EU, and simulate their deterrence effects under different assumptions on the legal and economic environment. It is likely that European fines have not had significant deterrence effects before leniency programs were introduced. Previous simulations of the 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 falls to extremely low levels (below 10% of the optimal "Beckerian" fine). Strategic judgment-proofness can and should be prevented by suitable regulation or extended liability. Criminal sanctions, in the form of imprisonment, certainly bring benefits (and costs) in terms of cartel deterrence, but the firms' limited ability to pay does not appear any longer such a strong argument for their introduction.

Keywords: antitrust, amnesty, cartels, collusion, corporate crime, debt, deterrence, extended liability, fines, law enforcement, leniency, immunity, imprisonment, judgment proofness, optimal fines, optimal sanctions, optimal liability, organized crime, political economy, rewards, sunk cost bias, whistleblowers

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Yet another method of preventing crimes is, to reward virtue. Upon this subject the laws of all nations are silent. If the rewards proposed by academies for the discovery of useful truths have increased our knowledge, and multiplied good books, is it not probable that rewards, distributed by the beneficent hand of a sovereign, would also multiply virtuous actions. (Cesare Beccaria, *Of Crime and Punishment*, Chapter 44: *Of Rewards*)

4.1. Introduction

The recent tendency towards the 'criminalization' of antitrust law in Europe, started with the reforms in Ireland (1996) and UK (1999–2001), and the drastic increase of jail terms for price fixing, introduced by the US Antitrust Criminal Penalty Enhancement and Reform Act in 2004, re-opened the never really settled debate on optimal sanctions against cartels. This paper discusses the issue in the light of two major recent innovations in the theory and practice of law enforcement—leniency programs and reward schemes for whistleblowers—whose novel type of deterrence effects could not have been taken into account in the early debate on optimal antitrust sanctions, and has been largely neglected in the current revival of that debate.[1]

In Section 4.2 we briefly review the evolution of the sanction policy adopted in the EU and the US, and discuss the optimality of current financial fines in the light of normative theory and available data. We simulate optimal financial fines against cartels—the minimal ones that have deterrence effects—according to the standard 'Beckerian' cost–benefit methodology used in previous work, and argue that the sanctions imposed by the European Commission (and by the competition authorities of many European countries) are likely to have been too low, and to have had little deterrence effects before the recent introduction of leniency programs and the parallel increase in fines. We suggest that pretending to enforce cartel prohibitions may have been part of a 'political equilibrium' that pleased everybody, but (dispersed) consumers and tax-payers, and that is no longer sustainable in a globalized world where developed countries that took a tougher stance in favor of competition perform better.

In Section 4.3 we briefly review the main costs and benefits of using imprisonment against price-fixers, and argue that the current debate is based on the wrong premises regarding the minimal size of corporate fines likely to have cartel-deterrence effects on well informed firms. We produce simulations of the minimum fines with cartel deterrence effects that take into account one of the several new deterrence effects well designed and implemented leniency programs bring about, and we find that, by neglecting these effects, previous simulations are likely to have substantially overestimated such minimal fines. We then produce simulations of the optimal fine with schemes that reward whistleblowers with the fines paid by the convicted partners, as proposed by Spagnolo

[1] See Rey (2003) for a brilliant and thorough discussion of the importance of implementation and enforcement issues for competition policy in general and cartel deterrence in particular.

(2000a), Buccirossi and Spagnolo (2001), Kovacic (2001), and Aubert et al. (2005), which have been successfully introduced in the last two decades by the US False Claim Act against government fraud. We show that, with such programs, the optimal fine against cartels lies below firms' normal ability to pay, overcoming a first main concern expressed in support of the introduction of imprisonment for price-fixers (firms' *exogenous* limited ability to pay).

In Section 4.4 we discuss the feasibility of schemes that reward whistleblowers, and argue that with well-designed and well-implemented mechanisms, well informed firms will have no reason to indemnify their managers fined for price-fixing, nor to give them incentives that induce them to fix prices in the first place. Given the change in the attitude of principals and the increased probability of self-reporting these schemes induce, financial sanctions on individual managers are also likely to become effective, alleviating a second main concern in support of imprisonment (indemnification of managers and their limited ability to pay).

We then discuss the possibility that firms strategically exploit bankruptcy law, *endogenously* reducing their ability to pay antitrust fines by issuing large amounts of debt that shield their assets, either because in some jurisdiction debt may be senior to fines, or because in most jurisdictions courts and agencies would not be willing to impose fines that drive firms bankrupt. Because of this strategic judgment-proofness response on the side of firms, policies that reduce fines for firms with lower ability to pay—often followed by courts and agencies and openly suggested by some legal scholars—are likely to be highly socially harmful: they both substantially reduce cartel deterrence, and generate additional inefficiencies (over and above that of non deterred cartels) by inducing colluding firms to distort their capital structure and undertake other cost-increasing activities that increase their judgment-proofness. In the absence of well-designed and well-implemented whistleblower schemes, it may be necessary to limit overborrowing by firms, or to extend liability to other stakeholders,[2] or to let some firms go bankrupt because of the fines, or to fine directly controlling shareholders—waiving all fines on a bankrupt firm to allow new owners to have a "fresh start". Well-designed and well-implemented whistleblower reward schemes would eliminate this problem at the root though, as the optimal fines become so low that no judgment-proofness problem would emerge.

We then discuss how individual liability, leniency programs, and individual rewards are likely to affect optimal fines; and how optimal fines for corporations change if managers are subject to the "Sunk Cost Bias"—as recent experimental evidence suggests—and raise post-conviction competitive prices to try recovering the fine.

Section 4.5 concludes with a brief summary of our main findings, some words of caution, and a suggestion for further, highly needed, theoretical and empirical research.

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[2] Analogous remedies have been analyzed and proposed for the enforcement of tort law and environmental regulation by Shavell (2004), Che and Spier (2005), and Hiriart and Martimort (2005).

Our chapter can be seen as a contribution to the literature trying to assess the likely cartel deterrence effects of antitrust law enforcement policies with simple or complex simulations, which includes work by Werden and Simon (1987), Gallo et al. (1994), Craycraft et al. (1997), McCoutcheon (1997), UK DTI (2001), Posner (2001), Wils (2003, 2005a), Connor (2004, 2005), and Chen and Harrington (2007, Chapter 3 in this volume).[3]

Together with Chen and Harrington (2007), this chapter presents the first analysis that simulates the likely deterrence effects of cartel enforcement after the introduction of effective leniency programs (1993 in the US, 1996 in the EU) without overlooking the novel, additional deterrence effects these introduce.[4] However, our paper differs from the work by Chen and Harrington, that focuses on the likely effects on cartel prices and formation of different degrees of leniency given the level of fines, because it focuses on the likely change in the optimal fines and the need for incarceration determined by the introduction of effective leniency and whistleblowers schemes. The two chapters can, therefore, be regarded as complementary.

Throughout our chapter we maintain the classic economic perspective on the analysis of efficient law enforcement. Cartels are punished by cease and desist orders and by the imposition of administrative and, in some jurisdictions, criminal sanctions. The primary objective of these sanctions is to ensure deterrence (i.e. prevention) of anticompetitive behavior. This requires the sanction to be set at a level that changes companies' and individuals' incentives so as to discourage them from adopting unlawful conducts. Economic theory provides the analytical tools to address the issue of the optimal sanction policy against cartels. A large body of literature, starting from the seminal work of Becker (1968), has addressed the general question of the optimal public enforcement of law. This literature has taken up a vast array of policy issues, from the optimal amount of resources to be devoted to apprehending violators, to the appropriate form of the sanction between fine and imprisonment, and many many others (see Polinsky and Shavell, 2000, for a rich survey).

Several contributions within this body of literature address specificities of antitrust law enforcement (see, e.g., Landes, 1983), and a lively debate on whether antitrust infringements should be punished only with administrative/pecuniary fines or also with imprisonment took place already in the 70s and 80s (see the many references in Werden and Simon, 1987). Our contribution builds heavily on this literature, and tries to highlight peculiarities of cartels, some of which previously neglected, that suggest the need for some amendments of the prescriptions of the received normative theory. These are:

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[3] An alternative important way of trying to assess the deterrence effects of antitrust law enforcement policy is that of running laboratory experiments, as done by Apesteguia et al. (2003), Hamaguchi and Kawagoe (2005), and Hinloopen and Soetevent (2005).

[4] If well designed and managed; see Spagnolo (2006) for a survey of economic analyses on the bright and dark sides of leniency programs.

(a) sanctions against cartels must not impair future competition;
(b) cartels are multi-agent infringements;
(c) cartels are carried out by limited liability organizations with internal agency problems.

Features (b) and (c) are particularly important. They can be referred to as the team properties of cartels. Our simulations demonstrate how important it is to consider team properties when designing an optimal sanction policy against cartels, particularly when a well-designed leniency or whistleblower program is in place. These properties impose limits to the set of feasible or desirable sanction policies and provide opportunities to accomplish results that would have been beyond our reach in their absence. These limits and opportunities stem from the existence of a number of implicit and explicit contracts that govern the relationships between team members, both within a firm and among distinct firms. We must recognize that the imposition of sanctions alters not only the incentive of a firm to comply with the law, as if the firm were an individual making isolated rational decisions, but also modifies the way implicit and explicit contracts between agents in each firm are shaped and implemented. Since both illegal and legal (efficient) conducts rely on these contracts, sanctions may achieve their aim by rendering some of these contracts unfeasible.

4.2. Fines without leniency

In this section we review and compare the methods for calculating fines against cartels used in the US and in the EU, with particular focus on the maximum fines that can be imposed. We evaluate whether these fines are consistent with the prescriptions of standard theory and we simulate their deterrence effects according to the standard methodology. We then argue that the EU policy of low fines, not reinforced by the threat of imprisonment, is likely to be the outcome of a no more sustainable political equilibrium.

4.2.1. Fines against cartels: US vs. EU

US sanctions against cartels

In the US cartels are felonies that can be punished with fines on individuals and corporations and imprisonment for individuals. The level of these sanctions is defined by the Antitrust Criminal Penalty Enhancement and Reform Act of 2004. The Act increased the maximum statutory criminal fine for individuals from 350.000 to 1 million US Dollars; the maximum jail term from 3 to 10 years; and the maximum statutory fine against corporations from 10 to 100 million US Dollars or—as before the reform—twice the gain of the violator or the loss of the victim. The US Sentencing Guidelines (USSG) govern the application of these sanctions for antitrust.

According to the USSG, which are now under revision, to determine the appropriate corporate fine it is necessary to calculate a base fine. The base fine is equal to the highest between the pecuniary gain of the violator or the pecuniary loss of the victims. In general this fine is based on the loss because the loss from price-fixing normally exceeds the gain. In addition, since the average gain from price-fixing is estimated to be around 10% of the selling price, the pecuniary loss is assumed to be of the order of 20% of the affected commerce. However, in those cases in which the cartel price appears to include substantially more or less than a 10% overcharge, the fine is adjusted accordingly. This mechanism for assessing the fine, unique to antitrust enforcement, has the purpose of avoiding the time and expense that would be required to determine the actual gain or loss. This base fine is then multiplied by a minimum or maximum multiplier that can range between 0.75 and 4. The multiplier depends on the organization's culpability that can take a score from 0 to 10. This score is determined by adding and subtracting enhancements and reductions from a five-point base score, where enhancements stems from the involvement of high level personnel, prior criminal or civil adjudications for similar conduct, violation of an order and obstruction of justices, and subtractions are granted for an effective program to prevent and detect violations of law, and for self reporting, cooperation and acceptance of responsibility. A culpability score of 10 leads to a minimum multiplier of 2 and a maximum multiplier of 4. A culpability score of 0 results in a minimum multiplier of .05 and a maximum multiplier of 2. However, for cartels the minimum multiplier can never be below .75. Therefore a fine can range from 15 percent of the volume of commerce to a maximum of 80 percent of this volume.[5]

These guidelines are currently subject of an intense debate that may lead to a reform that could substantially increase fines against price-fixers (see, e.g., ABA Section of Antitrust Law 2005). In addition, the "20% of affected commerce" rule of thumb, outlined in the USSG, is "under revision" after the Supreme Court found unconstitutional to base sanctions on a finding that was not subject to a jury decision. Since there is recent evidence that the presumption of a 10% increase in price substantially underestimate the average collusive price overcharges (see, e.g., Connor, 2003, 2004; Connor and Lande, 2004), the change in methodology is likely to increase the baseline fine against cartels. The culpability score is also "under revision", since the US Sentencing Commission has proposed amendments to the Antitrust Recommendations of the USSG that would substantially raise both pecuniary and non-pecuniary baseline sanctions against price-fixers.

In the recent past, US pecuniary sanctions have almost reached the maximum of 80% of US affected commerce (in the *Mitsubishi* case, in 2001, the fine was set to 76% of affected commerce; see Connor, 2003). However, even under current USSG, cartels with a well documented price overcharge could attract higher

[5] For a more detailed description of the US sanctioning policy and some examples see Kobayashi (2002). An in depth comparison of US and EU methods for setting fines is in Ch. 2 of Motchenkova (2005).

fines, since the 10% presumption would be replaced by the real overcharge. A documented 30% overcharge, doubled and multiplied for a culpability factor of 4.5 can lead to a fine equal to 270% of affected commerce. Moreover, US prosecutors could start basing fines on global, rather than US affected commerce, which could more than double pecuniary fines.

Of course, all this applies if the wrongdoer does not negotiate the fine in exchange for pleading guilty, and if he is not eligible for amnesty under the leniency program. As is well known, if a firm is the first to apply for leniency reporting valuable information on a cartel either unknown to the DoJ, or on which the DoJ had little evidence about, it is eligible to full immunity from sanctions under the US Corporate Leniency Program.

Sanctions in the European Union

Pursuant to Article 23(2) of Regulation No. 1/2003, the European Commission (EC) may impose fines on undertakings or association of undertakings that, either intentionally or negligently, infringe Article 81 of the Treaty up to 10% of their total turnover. Article 23 also states that, to this extent, fines shall be computed having regard to the gravity and duration of the infringement (par. 3). In 1998 the EC adopted its first Notice on the method for calculating fines in antitrust cases. This notice has been revised in June 2006 and new Guidelines have been published in September 2006 (O.J. 2006/C 210/02). This document binds the EC to follow a two-step method in setting the amount of the fine. In step one the EC determines the basic amount of the fine. In step two it may adjust the basic amount taking into account: aggravating and mitigating circumstances; the application of the leniency notice; the undertaking's ability to pay; the need to ensure sufficient deterrence; and the legal maximum set in Regulation 1/2003 according to which the fine cannot exceed 10% of the total turnover in the preceding business year of the undertaking concerned.

The revised Guidelines provide that the basic amount (step one) will be determined as a fraction of the company's annual sales to which the infringement relates on a scale from 0% to 30%, depending on the gravity of the infringement. This amount is then multiplied by the number of years of participation in the infringement. For hard-core cartels, the Guidelines state that the proportion of the value of sales taken into account will generally be set at the higher end of the scale. Moreover, irrespective of the duration of the undertaking's participation in the infringement, they will be subject to an "entry fee" as the EC will include in the basic amount a sum of between 15% and 25% of the value of the affected sales.

This basic amount may be increased or decreased (step two) if the EC considers that certain aggravating or mitigating circumstances actually occurred. Particularly, the fine may be increased in case of: (a) Repeated infringement of the same type by the same undertaking; (b) Refusal to cooperate with or attempts to obstruct the EC in carrying out its investigations; (c) Retaliatory measures against other undertakings with a view of enforcing practices which constitute an infringement.

Table 4.1: Fines imposed by US and EU authorities in five global cartel cases (million of dollars).

Cartel	US	EU
Lysine	92.5	97.9
Citric acid	110.4	120.4
Vitamins	906.5	756.9
Sodium gluconate	32.5	51.2
Graphite electrodes	436.0	172.0
Total	1,577.9	1,213.3

On the contrary, the fine will be reduced where attenuating circumstances occurred, such as: (a) An exclusively passive or follow-my-leader role in the infringement; (b) Non-implementation in practice of the offending agreements and practices; (c) Termination of the infringement as soon as the EC intervenes (in particular when it carries out checks); (d) Effective cooperation in the proceedings, outside the scope of the Notice on the non-imposition of fines or reduction of fines in cartel cases. The EC may grant a reduction or even waive the fine if one or more of the undertakings involved in the cartel cooperate in detecting or proving the unlawful behavior. The conditions under which a firm can benefit from this reduction/waive are set out in the so-called leniency program. The EC may further adjust the fine upward or downward, in order to take into consideration any economic or financial benefit derived by the offenders, so as to ensure deterrence. Finally, in exceptional circumstances, the EC takes into account the undertaking's inability to pay and reduce the fine if its full imposition would irretrievably jeopardize the economic viability of the undertaking concerned and cause its assets to lose all their value.

According to Connor (2003) the level of fines for comparable global cartel cases is only slightly higher in the US than in the EU. Table 4.1 reports the total fines imposed on cartel members in five cases prosecuted from 1996 to 2002. With the exception of the *Graphite Electrodes* case, where the overall US fine is substantially higher than the EU one, in all the other cases the magnitude of the fine is roughly the same in the two jurisdictions. Hence, since in EU private antitrust enforcement is negligible and, criminal sanctions are absent, the deterrence effects of the current EU legal regime are clearly lower than in the US. Since many cartels still form and are detected in the US, the level of the sanctions in the EU is likely to be insufficient.[6]

Table 4.2 reports a sample of cartels investigated in the EU and shows the duration of the cartel ascertained by the EC[7] and the fine, before any reduction

[6] As pointed out by a referee, an increase in the financial sanctions in the EU may still not suffice to obtain the same level of deterrence of the US antitrust enforcement system, as jail sentences and fines may have intrinsic differences. We do not discuss this point in this chapter although we note some peculiarities of imprisonment in the discussion of its advantages and disadvantages (Section 4.2.4).

[7] The numbers in the table report the minimum and maximum duration of the infringement considering all cartel members. The highest figure is to be considered the life span of the cartel as the

Table 4.2: Fines imposed by the EC in some global cartel cases.

Cartel	**Year of the decision**	**Duration (years)**	**Fine over global turnover**	**Fine over EEA turnover**
Pre-insulated pipes	1998	1–5	n.a.	32.2%
Seamless steel tubes	1999	4–5	12.9%	54.0%
Lysine	2000	3–5	25.8%	99.5%
Citric acid	2001	3–4	40.6%	100.1%
Vitamins	2001	3–9	54.5%	241.2%

Table 4.3: Fines imposed by the EC for each cartel in the *Vitamins* case.

Market (vitamin)	**Duration (years)**	**European sales outside the cartel**	**Fine over EEA turnover**
A	9.5	9%	221.2%
E	8–9.5	8%	175.1%
B2	3.75–4.25	12%	397.9%
B5	8	7%	605.8%
C	4.7	22%	178.5%
D3	4.5	4%	411.6%
Beta-Carotene	6.3	0%	240.0%
Carotinoids	5.7	0%	353.4%

from to the application of the EU Leniency Program, as a percentage of the value of the market in one year in which the cartel was operating, according to the EC's decision, both worldwide or in the European Economic Area (EEA). The last figure does not refer to the sales affected by the cartel as it is computed only with reference to the revenues generated in one year, whereas these cartels lasted for several years.[8]

These data indicate a sharp increase in the severity of the fines imposed on cartels by the EC. Over just four years the fine, from a fraction of the affected commerce (European turnover), became a multiple of it. However, it would be wrong to conclude that the EC has decided to clearly relate fines to the dimension of the market and, therefore, to the likely harm caused by the infringement. The *Vitamins* decision is quite interesting as it concerned several markets and involved distinct cartels. Table 4.3 shows, for each of these cartels, its duration,

lowest figure is mainly due to the fact that some firms entered the market (and joined the cartel) only after some time. The *Vitamins* case concerned several markets and several cartels that had different duration.

[8] Unfortunately, the information reported in this table is limited because most of the data are omitted from the Commission decisions, especially in the most recent ones. It is apparent that the size of the affected commerce is not an important factor as in many decisions we have consulted this information is not reported at all. In some cases, while the original decision contains such information, the published version does not. We do understand that individual firm data (even if generally refers to 4–5 years before) may constitute business secrets, but we do not see any good reason for omitting aggregated values.

the share of the market served by the fringe firms outside the cartel, and the fine imposed on cartel members as a percentage of the value of the European market. It is very difficult to rationalize these figures. Their level (in percentage terms) does not seem to be correlated either to the duration of the cartel or to the share of the market covered by the cartel.[9]

4.2.2. How (in)adequate have been fines before leniency?

4.2.2.1. Theory

The modern economic theory of public enforcement of law which stems from Becker's (1968) seminal paper, focuses, with few exceptions, on a single crime of short duration and a single wrongdoer. The main objective considered is efficient deterrence, i.e. deterring crime only when it is efficient to do so and in the most efficient way (see, e.g., Polinsky and Shavell, 2000). The simple rule it suggests is to deter crime only when the harm it causes, H, is larger than the benefit B accruing to the criminal, and to do it by setting the sanction, S, and the probability of detection, α, so that the expected sanction just equals the harm, i.e.:

$$S\alpha = H.$$

An adaptation of this rule to antitrust violations is provided by Landes (1983). In the case of cartels, B represents the additional collusive profits plus any cost saving or quality improvement the coordinated practice may generate, net of any cartel enforcement expenditure, while H represents the consumer surplus transferred to firms in the form of collusive profits plus the utility of the foregone consumption due to the higher price (H). Some observers think that for 'hard core' cartels the condition $B < H$ is always satisfied and that there are no such infringements that may enhance social welfare.[10] Hence, according to the rule above, the efficient expected fine should be set at a level that deter all possible cartels. If we accept this view and the conventional assumption that fines are socially costless, as they represent mere transfers of money, while imprisonment entails positive social costs, then the only robust principles from the theory of optimal law enforcement left for cartels are:

1. To set fines maximal in order to save on inspection costs.
2. Not to use costly imprisonment before having set fines (and other administrative sanctions) maximal to save on imprisonment costs.

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[9] For a detailed, critical and well document analysis of the EC fining policy see the very rich paper of Geradin and Henry (2005).

[10] For example, Werden and Simon (1987) write: "We believe that efficient hard-core price-fixing is no more likely than efficient child molestation." (p. 932) On the other hand, Stiglitz (1989), Fershtman and Pakes (2000), Kranton (2003), and Calzolari and Spagnolo (2005) suggest that in situations where non-contractable quality is very important, restricting price competition may improve the effectiveness of reputational forces, and increase non-contractible quality and consumer welfare.

Risk aversion and legal errors would reduce the optimal fine, but in the case of managers and firms the hypothesis of risk neutrality appears more appropriate, and with risk neutral agents errors do not necessarily change the prescription of maximal fines, and may even imply higher optimal fines than without mistakes (see Polinsky and Shavell, 2000, pp. 60–62). A simple corollary of these statements is that the fines for firms that engage in cartels do not have to be related to their gains, nor to the losses caused to others: they just have to be sufficiently high to deter cartels while keeping to the minimum the cost of investigation and prosecution.

These simple prescriptions appear somewhat in contrast with the actual fining policy in the EU and in the US. In both jurisdictions current legislation (i) sets an exogenous ceiling to the maximum applicable fine; and (ii) *attempts* to relate the fine to a rough measure of the consequences of the cartel either on the colluding firms or on the victims.

Bankruptcy. The existence of caps in terms of a percentage of affected commerce or of overall firm turnover is often justified on the ground that legislators, while interested in deterring collusion, are also interested that firms keep producing (and competing) after conviction. High fines that may jeopardize a firm's financial stability may therefore have been perceived as running against the ultimate goal of antitrust law. This consideration, unique to corporate and antitrust law, is often mentioned in policy debate, where the number of active competitors is used as a proxy for the degree of competition. The same argument may render very high fines not credible, as agencies and judges may autonomously choose not to apply (to reduce) them when they can seriously jeopardize the existence of a firm, with all its "innocent" stakeholders.[11]

This argument, however, has strong limitations. First, no jurisdiction sets fines that could affect firms' survival possibilities. Craycraft et al. (1997), for example, find evidence that courts indeed reduce fines when a firm's ability to pay appears low (which makes caps redundant), and that in the majority of the US cases they analyze, firms could have afforded to pay the optimal cartel-deterring Beckerian fine from their normal cash flow, while they were imposed fines that were only a fraction of the optimal ones.

Second, it is important to remember that antitrust law exists to deter cartels, and thereby to protect and foster competition in all industries, today and tomorrow. If fines became sufficiently high that some convicted cartel members went bankrupt, antitrust enforcement would have decreased the number of firms and (perhaps) competition in the industry of the convicted cartel *for a period* (until bankrupt firms changed hands and became again competitive, or other forms of entry took place), but, at the same time, they could have increased competition through ex ante, general deterrence *in many other industries*. The overall net effect might well be positive.

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[11] We wrote "innocent" because some stakeholders (like banks or unions) are often at the root of stable cartels. See Spagnolo (2003) and Buccirossi and Spagnolo (2006).

Third, if bankruptcy procedures are efficient (and they could be efficient), the negative effect on that industry's competition may be small, or even absent when the technically bankrupt firm is rapidly sold to new owners who then get a "fresh start" with a complete waiving of all the fine, and who may have more financial resources and a more aggressive attitudes (e.g., less "established connections" with other firms) than the old ones. In addition, if fines are sufficiently high to have robust deterrence effects, possibly leading firms to bankruptcy, and knowledge of this is widespread in the business community, then much fewer cartels will form, and even fewer will be detected and fined, which reduces further the relevance of the above argument.

Finally, as will be further discussed later on, this argument is risky because it may lead to the dangerous idea that—to avoid bankruptcy costs—fines should depend on the financial strength of the firm, i.e. should be higher for firms that have less debt and more cash and lower for financially weaker firms with a lower ability to pay. Such a policy might push cartel members to issue more debt, so that the level of the apparent ability to pay and expected fines fall, adding to the social cost of collusion, that stemming from firms' inefficient financial structure.

We believe that the reasons behind the low fines imposed in the EU, which are well below the level that could deter cartels, are political rather than economic based.

Proportionality. The second feature of the current fining policy, i.e. the principle of proportionality, has a clear economic explanation—even continuing to assume that all cartels are inefficient—once we reject the assumption that fines are socially costless. Indeed, if high fines, coupled with the possibility of legal errors, deter to some extent also socially desirable behavior, increasing the fines behind what is strictly necessary to deter illegal conducts reduces social welfare. If we take into account this social cost of raising fines against cartels, then it may be optimal to set the fine at a lower level, so that the marginal social benefit of deterring cartels equals the marginal social cost of mistakenly deterring efficient conduct. The optimal level of the fine and of deterrence depends then on the extent to which the expected fine is likely to discourage efficient conducts, which may consist either in forms of cooperation with other firms whose object and effects are pro-competitive and may be misjudged as collusive, or in an efficient internal organization that is however less adequate to detect antitrust violations within the firm. Whether these costs are relevant and what is their magnitude is an empirical matter, and is directly linked to the frequency with which courts commit type I errors (false convictions). If these costs are to be taken into consideration, the need to relate the level of the fine to the harm caused or the benefit produced by the illegal behavior is reestablished.

A third feature of the current sanction policy in the US is the recourse to *imprisonment*, which according the to standard economic theory of law enforcement is sound only if, given the existing limits on fines, the level of the expected penalties is too low (see, e.g., Polinsky and Shavell, 2000; for an interesting and quite persuasive alternative view, see Werden and Simon, 1987). Imprisonment

will be discussed in depth later on, here we simply observe that, since the level of total expected penalties for similar infringements in the US is higher than in the EU, at least in one of the two jurisdictions the sanction policy against cartels is likely to be suboptimal. We believe that the level of sanctions in the EU is and has always been too low to have strong cartel deterrence effects, and most commentators (at least all those who call for the introduction of criminal sanctions) seem to agree.

4.2.2.2. Old-method simulations

To sustain our claim that it is likely that EU fines have not had significant deterrence effect on cartels, at least not before the introduction of leniency programs, we have run a simple and prudent simulation using a wide set of plausible parameter configurations, following the standard expected costs-expected benefits methodology used in previous studies.[12] In the next section we will explain why this standard methodology is appropriate when there is no effective leniency program in place, but it gives misleading results when such a program is in place, such as in the US after 1993 and in the EU after 1996.

Let us define the following variables:

c is the constant marginal cost;
m is the competitive mark-up, i.e. the competitive price is $p = c(1 + m)$;
q is the individual quantity demanded at the competitive price;
k is the percentage price increase due to the cartel, i.e. $p^m = p(1 + k)$ is the collusive price;[13]
ε is the (absolute value of the) demand elasticity at the competitive price;
α is the probability of detection; and
f is the fine expressed as a fraction of firm's revenue in the affected market.

In the non-cartelized market profits are $\pi = qcm$.[14] If firms form a cartel and increase the price from p to p^m, each of them sells $q^m = q(1 - \varepsilon k)$ gaining

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[12] As mentioned in the introduction, analogous 'back of the envelope' calculations for particular parameter constellations are in Werden and Simon (1987) and Gallo et al. (1994, 1997) for environments or periods without effective leniency programs, and in UK Ministry of Trade (2001), Posner (2001), Wils (2003, 2005a), and—with the novel twist of an international cartels perspective—Connor (2003, 2005), for environments or periods where effective leniency programs were already present.

[13] Of course in reality and in oligopoly models this parameter is endogenous, but our simulations encompass many values of this parameter, thereby covering many possible models and real world situation.

[14] In a perfectly competitive market either m is zero or firms have fixed costs such that actual profits are zero. Alternatively, we can imagine that also in the non cartelized market the equilibrium is not perfectly competitive and firms gain positive profits. Which of the above assumptions is true is irrelevant for the following discussion as what matters for the decision of forming a cartel is only the magnitude of the profits variation due to the cartel formation.

collusive profits $\pi^m = qc(1-\varepsilon k)[k(1+m)+m]$. Therefore, a colluding firm increases its profits by:

$$\pi^m - \pi = qkc\big[(1+m)(1-\varepsilon k) - \varepsilon m\big].$$

Revenues in the affected market at the colluding price are:

$$qc(1+m)(1+k)(1-\varepsilon k),$$

and the expected fine is:

$$\alpha f qc(1+m)(1+k)(1-\varepsilon k).$$

Let f^* be the minimum fine with deterrence effects, that is the fine such that the expected gain from participating in the cartel, given by the increase in profits minus the expected fine, is zero. We have:

$$f^*(\alpha, k, \varepsilon, m) = \frac{k[(1+m)(1-\varepsilon k) - \varepsilon m]}{\alpha(1+m)(1+k)(1-\varepsilon k)}. \tag{4.1}$$

If $m = 0$, the minimum fine (4.1) becomes:

$$f^* = \frac{k}{\alpha(1+k)}. \tag{4.2}$$

Note that the minimum fine is defined with respect to the revenues of a firm over the entire period in which the cartel is active and successful.

Levenstein and Suslow (2002) analyze case studies of a sample of cartels discovered in the 1990s in the US, and find that cartels seem to last on average 5 years, and to raise prices from 10 to 100%, with a median collusive mark-up of 25%. John Connor (2004) surveys hundreds of published social-science studies of private, hard-core cartels collecting 674 observations of long-run overcharges. He finds that the median overcharge for all types of cartels over all time periods is 25%: 18% for domestic cartels and 32% for international cartels. Outside the US, data on 62 decisions of competition commissions cited median overcharge of 29% and a mean of 49%.

As for the probability of detection, unfortunately we have no reliable estimate of this parameter, and this is clearly an important topic for future research.[15]

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[15] The most often quoted and rigorous work on this is Bryant and Eckard (1991). These authors, however, model and estimate a birth–death process for *convicted* cartels between 1961 and 1988. They estimate the probability for a cartel to be convicted *in a given year*, and *conditional on being convicted*, to be between 0.13 and 0.17. Because we do not know the number of non-convicted cartel that were present in that same period, nor whether non-convicted cartels had on average the same characteristics of convicted ones, it is very hard to assess precisely the generic probability of being convicted in a given year faced by a cartel that does not know whether it will be convicted. Their result only estimates that *it cannot be higher than* 0.13–0.17 *per year*. It would be exactly in that interval if all the cartels were convicted with probability one, of about one order of magnitude smaller (about 0.013–0.017 per year) if one out of ten cartels were convicted, of two orders of magnitude smaller if one out of hundred cartels were convicted, and so on. Even less can be said about cartels' perceived probability of detection, which is what really matters.

Table 4.4: Minimum fine expressed as a percentage of the firm's revenue in the affected market for different levels of the competitive mark-up and the demand elasticity.

m	ε								
	.1	**.2**	**.3**	**.5**	**1**	**2**	**3**	**4**	**5**
.01	.605	.605	.604	.603	.599	.591	.580	.566	.546
.03	.604	.602	.601	.597	.586	.562	.530	.488	.430
.05	.603	.600	.597	.591	.574	.534	.482	.414	.317
.07	.602	.598	.594	.585	.562	.507	.436	.342	.210
.09	.601	.596	.591	.580	.550	.481	.392	.272	.106
.11	.600	.594	.587	.574	.539	.456	.349	.206	.005
.13	.599	.592	.584	.569	.529	.432	.307	.141	n.p.
.15	.598	.590	.582	.564	.518	.408	.267	.079	n.p.

Werden and Simon (1987) assume in their calculations that one out of ten cartels is caught by the DoJ, and used in their simulations a probability that a cartel is detected at all—i.e. in its whole lifetime—of 0.10. Given that the DoJ can use tougher investigative methods than the EC, it is likely that the probability of cartels detection is lower for the EU. Moreover, what matters for deterrence is the probability of detection as perceived by the potential wrongdoers, and many agents tend to be overoptimistic regarding their probability of success (see, e.g., Camerer, 2003; Jolls, 2004).

A prudent stance relative to previous simulation would, therefore, be to assume a collusive mark-up (k) equal to .1, as suggested by the USSG, and a perceived probability of detection equal to .15. If we assume that the competitive mark-up (m) is zero this suffices to identify the minimum fine with deterrence effect (Equation (4.2)) that is equal to 61% of firms revenue in the affected market. This value is largely dependent on the magnitude of the collusive mark-up. If we take the value of .29, reported by Connor (2004), as the median overcharge for cartel cases outside the US, to deter the median cartel the fine should be set at 150% of the firms' revenue. *These percentages have to be applied to the revenues of the firm over the entire period of the successful activity of the cartel.*

Table 4.4 reports the results of our simulation and shows the level, expressed as a fraction of the firm's revenue, that the minimum fine would take for a range of values of the competitive mark-up (m) and of the demand elasticity (ε), while holding constant the value of the collusive mark-up ($k = .1$) and of the probability of detection ($\alpha = .15$).

When the competitive mark-up over marginal costs is high (over .13) and the price elasticity is 5 or more a further price increase of 10% is not profitable. The values reported in the table show that when the collusive overcharge is 10% the minimum fine ranges from about 60% to 0.5%, depending on the value of the demand elasticity. With a demand elasticity of 1, the minimum fine with deterrence effects varies between 50% and 60% of the sales in the relevant market. The interested reader can easily compute the value of the minimum fine when

the collusive mark-up is higher. For instance if the overcharge is .29 and the elasticity is 1, the minimum fine ranges from 122% to 148%. This shows that it is likely that the current level of the financial penalties imposed in the EU (reported in Table 4.2) has been inadequate to deter cartels that have the ability to raise price by 10% or more and that face a relatively inelastic demand. Note also that a fine below 10% of the firm's turnover in the affected market (over the full period of collusion) is sufficient to deter collusion (if all the other assumptions hold), only if the demand elasticity is at least 4 and if the competitive mark-up is above 10%. Even in these (exceptional) cases the minimum fine may exceed the maximum threshold set in the EU if the conspiracy lasts more than one year and if the affected market generates a substantial fraction of the entire firm's turnover.

4.2.3. A 'Political Economy' interpretation of EU mild sanctions

The simulation presented in the previous section and analogous simulations previously run by other researchers suggest that, both at the EU level and in most European countries sanctions against price-fixing have been too low in the past to have had substantial deterrence effects, particularly in the absence of leniency programs.

EU antitrust enforcement against cartels before leniency programs. Spending public resources in a law enforcement policy that has a small deterrence effect on a crime may be less efficient than having no law enforcement at all. Scarce public money is spent to support agencies, investigations and trials, while private money and effort are spent to try avoid/reduce fines. For a policy to be efficient, law enforcement costs borne by society must be compensated by substantial social benefits in terms of crime deterrence.

Consider three possible worlds: one with sufficiently tough sanctions against cartels such that the costly enforcement of antitrust laws has substantial cartel deterrence effects (say, the US); one without enforcement of antitrust laws (say, China); and one with very mild sanctions against cartels, where the costly enforcement of antitrust laws has little or no cartel deterrence effects. The third one is likely to be the worst, as society bears the cost of antitrust enforcement (cost of public agencies, lawyers, courts) without a valid return in terms of reduced rate of collusion.[16]

Note that our claim is different from that advanced by Crandall and Winston (2003). These authors argue that it is likely that US antitrust law enforcement *in general* has not had large positive effects on consumers, and support their

[16] Of course all policies should have a positive net return, and he cost of competition policy are very small compared to other policies. There are so many enormously more expensive policies (just think at agricultural policies in the EU and US) with obvious and large negative returns to society that discussing antitrust policy in this respect is perhaps a bit unfair.

claim with a limited selection of (rather old) cases and an aggregate data analysis. The weaknesses in their analysis have been already pointed out by Baker (2003), Werden (2003), and Kwoka (2003).

Our more narrow claims are, instead, that:

(a) if expected sanctions against a crime are too low to have relevant deterrence effects, then the law enforcement activity is unproductive from an economic point of view and the investigation and prosecution costs are deadweight losses for society (i.e. they do not produce sufficient social benefits that balance them, apart from the compensation of the victims, a pure transfer); and
(b) our and other researchers' simple simulations suggest that expected sanctions against cartels in Europe may have been too low to have substantial deterrence effects on cartels, at least before the introduction of the leniency program.

Competition law with weak enforcement as a 'political equilibrium' in Europe. How did we arrive to a situation of inefficient antitrust enforcement in Europe, which lasted for several decades? Europe is not isolated in this. Gallo et al. (1994, 1997) showed empirically that, even if we include imprisonment and damages, US sanctions before the 90s have fallen short of the level necessary to have deterrence effects. And McCoutcheon (1997) presents a subtle political economy theory of 'low but not too low' antitrust sanctions in the US, which argues that before leniency programs and the increase in sanctions of the recent years, the US legal framework did not deter cartel formation, but instead deterred meetings to renegotiate cartel strategies, thereby increasing the credibility of threats against defectors and stabilizing cartels!

The likely insufficiency of EU sanctions before leniency was introduced was particularly evident because of the absence of imprisonment. We propose a much simpler potential 'political economy' explanation, based as usual on the weak incentives of dispersed consumers to organize themselves to defend their interests, together with a tradition of government-encouraged cooperative/collusive attitudes in most (protected) European industries. In this context, a policy that pretended to enforce cartel prohibitions by an active inspection and prosecution activity, but imposed sanctions with no deterrence effects, satisfied many parties at the same time. Firms could continue avoiding serious competition in the EU and jointly exploit monopoly power by only paying a rather low expected tax on collusive profits called 'antitrust'. Politicians were happy because they could (a) show abroad that they had a competition policy; (b) have profitable firms enjoying a quiet life and willing to pay to support them; (c) avoid confrontations with powerful unions, since lively competition requires a continuous reallocation of workforce (firms striving for cost efficiency shed workers, while more efficient firms grow). The agencies in charge of competition law enforcement and antitrust law firms also gained because sanctions without deterrence effects increase the number of antitrust infringements to prosecute. The unions benefited too from this situation because part of the collusive rents produced by

the cartels typically trickled down to the employees (e.g., benefits, job security, etc.). And banks enjoyed financing firms earning a constant, fat collusive stream of profits.

A weak enforcement of competition law made therefore, in the short run, "everybody happy but the consumer". However, lack of competition means less productivity and innovation, which ensures that in an international arena such a political equilibrium cannot last long. The strong differential in economic performance between Europe and the US in the 90s and the loss of power suffered by the unions, linked to the fall of Berlin's wall, may have been two major events leading to the current "European movement" towards more effective antitrust law enforcement.

Of course, as noted by a referee, the difference in the severity of antitrust sanctions between the US and the EU may have more simply been due to sanctions being generally lower in Europe than in the US, most likely because the latter is a multi-racial society with higher mobility and a looser social pattern, therefore with more crime problems requiring tougher sanctions. Another, non-exclusive potential explanation is that Europe is a follower in terms of antitrust law and enforcement, and it requires time to credibly develop the political support for tough enforcement policies. (The US have followed a similar historical pattern, and the US cartel enforcement was also very weak before the 70s.)

4.2.4. Cartels and imprisonment: An old debate reopened

On the basis of the rather negative results of the simulation discussed above, one may be left with the impression that tougher criminal sanctions, in particular jail sentences, are the only credible legal instrument to deter hard-core cartels. Indeed, the new tendency towards criminalization taken by antitrust laws in Europe, as well as the widespread introduction of leniency programs inspired by the one of the US DoJ, appear as a sound—though late—reaction to an inadequate antitrust law enforcement. The EC and *some* governments seem to have recognized that to enforce prohibitions of price fixing, sufficiently strong sanctions are necessary. However, the need for more effective enforcement and tougher sanctions does not automatically imply a compulsory recourse to criminalization and imprisonment. In the remainder of this paper, when writing about criminal sanctions we will mainly refer to imprisonment, as financial criminal sanctions are likely to have some of the drawbacks of imprisonment, but few of its benefits.

Advantages of imprisonment. The US debate of the seventies and eighties, and in particular Werden and Simon (1987) highlighted a number of the benefits of sentencing price-fixers to jail, and the recent revival of this debate, in our view, has added little to the old one.[17] The most important arguments in favor of imprisonment, in our view, remain the following:

[17] Wils (2005a) discusses an analogous list of potential benefits of criminal sanctions from an EU competition law perspective, though not of their costs. See also Spagnolo (2005).

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[17] Wils (2005a) discusses an analogous list of potential benefits of criminal sanctions from an EU competition law perspective, though not of their costs. See also Spagnolo (2005).

(1) Limited liability may protect firm owners from paying the optimal fine, i.e. the *firms' inability to pay* a fine sufficiently large to have a cartel deterrence effect;
(2) Direct targeting of individuals responsible for their unlawful decisions and not of other innocent stakeholders, even when the former have limited wealth (and are therefore shielded from high fines);
(3) Partial solution to the "indemnification problem", i.e. of the possibility that firms reimburse the individual fine to their managers when their unlawful behavior was aimed at increasing shareholder value, as firms cannot easily buy-out a prison sentence against their managers;
(4) Short prison sentences may not be very costly and have a particularly strong psychological and "mediatic" effect as they are imposed on "white collars", while imposing large fines on corporations may instead be quite costly;
(5) More effective investigation tools become available, hence the probability of detection may increase;
(6) Reduction of future collusion through incapacitation (though directors can be disqualified even without criminal sanctions);
(7) Increased effectiveness of leniency programs, as the risk of tougher sanctions implies stronger incentives to apply for amnesty ('protection from punishment effect' through imprisonment strengthen the incentive to report, see Spagnolo, 2004).

In the remainder of this chapter we are going to discuss in depth the first of the benefits listed above, the limited ability to pay, that, in our opinion, is the most relevant. Indirectly, we will also discuss the second, indemnification, as it is strictly related to the first (i.e. if firms expect to pay sufficiently high fines, they would never indemnify any price-fixing manager). The effectiveness of leniency and whistle blowing programs is enhanced whenever the sanction (disutility of conviction) is increased, whatever its nature. Therefore, we can improve the effectiveness of leniency programs also by raising fines and, if the previous remark is correct, this need for stronger sanctions is not a persuasive reason in favor of imprisonment in itself. The relevance of the others, when compared to the costs of imprisonment, is at the end an empirical issue.

Disadvantages of imprisonment. The benefits of prison sanctions should be weighted against their well known drawbacks, which are not often considered in the current debate. These include:

(1) Jurisdictions—i.e. courts and juries instead of public agencies like the DG COMP—hence, typically, longer and more complex and costly procedures;
(2) Much higher standards of proof, hence a lower probability of conviction and deterrence;
(3) Much higher social cost of Type I errors when imprisonment is used (innocents in jail); including the indirect one of deterring people from undertaking socially valuable legal activities that risk being misunderstood/seen as a form of collusive behavior;

(4) High direct cost of imprisonment (both in terms of prison costs and of loss of the activity of the incapacitated managers/entrepreneurs);
(5) Negative externalities when criminal sanctions induce cartel members to adopt "tougher methods" to ensure cartel cohesiveness (see Spagnolo, 2005).

Tougher sanctions against price fixers, and generally a more effective antitrust law enforcement are highly needed in Europe; but it is not clear that this automatically implies criminalization and imprisonment. Some of their benefits would follow also from an increase in the toughness of other sanctions, both criminal or administrative. Since criminal sanctions in the form of imprisonment imply several additional costs, including the ones just mentioned, from an economic point of view it is not efficient to immediately adopt them before adopting all the less costly and potentially more effective administrative mechanisms (e.g., Polinsky and Shavell, 2000, Sections 3.1.3 and 4.1.3). Unfortunately, this has not been done. Given the additional costs of imprisonment, before accepting the conclusion that criminalization is the only feasible way to effectively deter hard-core cartels (or before saying to what extent criminalization is needed to reach this policy objective), we must ask whether we can improve the deterrence properties of pecuniary sanctions. In particular, we need to answer the following questions: How much could we increase the current value of fines without breaking the limit of the firm's ability to pay or impairing the firm's future ability to compete? Can we use financial (dis)incentives in a more efficient way? Do the team properties of cartels change the way we should envisage the sanction policy? We try to answer these questions in the next sections.

4.3. Leniency, whistleblowers, and optimal antitrust fines

Leniency programs for cartels were introduced in 1993 in the US and in 1996 (reinforced in 2002) in the EU.[18] These programs reduce sanctions against the first firm or individual that reports information on a cartel (or other multiagent crime) he took part in, and cooperate with the law enforcers until his former co-conspirators have been convicted. Among those features that are common to the EU and the US programs, there is the rule that only the first party that self reports is eligible to automatic full immunity from the sanctions; the rule that the second parties to self-report can still obtain some reduced forms of leniency;[19] and that the benefits from reporting are higher if it takes place before an investigation has begun, and rapidly falls the later the report it happens during the investigation.

[18] The US had a "low power" leniency program since 1978, that had little effects. See Spagnolo (2006) for further details.

[19] In the EU the parties that collaborate second or later may obtain a partial reduction in sanctions if they provide additional information; analogously, in the US firms that did not report first can still obtain substantial reductions in sanctions by collaborating at the prosecution stage and pleading guilty.

The effectiveness of these programs in destabilizing and deterring cartels can be reinforced by the offer of a reward to the wrongdoer (or witness) that first blows the whistle and self-reports turning in former partners (the reward could be financed by part or all the fines imposed on other wrongdoers).[20]

The potential impact of leniency and whistleblower programs on the effectiveness of a fining policy is enormous. The consequence that is probably most noted of adopting a leniency program is a plausible increase in the probability of detection and conviction, α. This has the immediate effect of raising the expected fine and of reducing the minimum optimal fine. Since the expected fine is a linear function of α, any factor that increases α by a proportion β reduces the minimum fine by the same proportion β. Even if this is the most highlighted effect of a leniency program, in our opinion, it is not necessarily the most important. We explain it is so in the next section.

4.3.1. Participation versus incentive constraints

The current debate on the optimal sanction policy is based on the assumption that the sanction should be set so that the participation constraint for would-be conspirators is no longer satisfied. This means that the expected gain from being part of a cartel should not be positive. Our simulation in Section 4.3 is based on the same assumption.

However, the modern theory of oligopoly and collusion, starting from Stigler (1964), teaches us that cartels are successful (i.e. they reduce welfare) only if participants have an incentive to stick to the agreed collusive market conduct, rather than to steal other participants' business by secretly undercutting the agreed cartel price. A cartel is feasible if participants are able to deter unilateral defections (like secret price cuts) by monitoring the members' behavior and by threatening credible sanctions against defectors. As in law enforcement, to achieve cartel enforcement the expected loss from being punished by partner cartel members in the future if detected cheating, must be larger than the gain from cheating/undercutting the cartel today. This condition, necessary for any cartel or illegal agreement to be sustainable, because of the impossibility to use explicit contract, is called "incentive compatibility" or "self-enforcing" constraint. It differs from the "participation" constraint on which the theory of law enforcement focuses, that requires the expected additional profits participants would earn from entering a cartel to be positive.

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[20] As proposed in Spagnolo (2000, 2004), Buccirossi and Spagnolo (2001), Kovacic (2001), and Aubert et al. (2005), and successfully done for other forms of multiagent crime, like government fraud under the US False Claim Act. We believe that the main efficiency enhancing potential of *well designed and implemented* leniency and whistleblower programs is not in terms of improved prosecution, but in their ability to *directly* deter, prevent cartel formation—avoiding costly prosecution altogether—by "undermining trust" among would be conspirators with the threat that one of them could then cheat on partners and self-report, turning the others in.

Several (old and recent) papers on optimal public law enforcement against cartels or other forms of organized crime—apart from the ones that use a dynamic model that endogenizes the effects of law enforcement variables on the incentive compatibility constraint—completely overlook this crucial aspect, by large the most important aspect when one wants to deters oligopolies and similar forms of multi-agent crime.[21] Both the participation and the incentive constraints must be satisfied simultaneously for all members of a cartel or of another organized criminal activity for this to be viable (so that if at least one of the two is violated for at least one member the cartel is deterred). And, as it turns out, it is much easier for law enforcers to ensure that the *incentive* constraint is violated for at least one of the members, by using leniency and whistleblower programs. Leniency and whistleblower programs can deter cartels by ensuring that the incentive/self-enforcing constraint is not satisfied, even when fines are much below those needed to ensure that the participation constraint of any wrongdoer is violated, i.e. the level that the standard theory of public law enforcement à la Becker considers necessary for a fine to have deterrence effects. To reiterate, a necessary condition for a cartel to be stable is that for each of its members the following inequality is satisfied:

Present value of expected collusive profits

$-$ expected sanction from antitrust conviction (F)

$>$ Expected profits from secretly deviating/undercutting the cartel price

$-$ expected antitrust sanction after deviating (F^d).

We can therefore deter a cartel by increasing individual members' incentives to undercut/betray their cartel: either by increasing the fines on those firms that respect the collusive agreement, F, but not on a firm that "betrayed" its cartel by secretly undercutting the agreed price, F^d; or, by lowering F^d, but not F. In principle, deterrence can therefore be obtained for any F if F^d is low enough (F^d could be negative, in which case it becomes a reward). This novel type of deterrence introduced by leniency programs and whistleblower schemes is not considered in the existing literature on optimal law enforcement, which typically maintains Becker's (1968) static perspective.[22] This more efficient type of deterrence may require fines which are much lower than the optimal "Beckerian" fines on which most of previous work focused. The next section will give an idea of how much smaller optimal fines are when coupled with leniency programs and whistleblower reward schemes.

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[21] Leniency programs where first formally analyzed within an appropriately dynamic model that endogenizes effects on the self-enforcing incentive constraint by Motta and Polo (2003), who focus mainly on their ability to facilitate prosecution.

[22] So far, this crucial fact, evident from the recent (dynamic) economic analyses of leniency programs, appears not to have been properly understood by legal scholars; the only law and economic work on optimal fines that does not overlook this fundamental point is, as far as we know, Camilli (2005).

4.3.2. Simulations

We will proceed step by step, introducing one aspect at time, to show that deterrence can be greatly improved with a more sophisticated use of financial incentives alone. To validate our claims, we use the simple simulation introduced in Section 4.3, assuming for simplicity that the competitive mark-up, m, is zero. We leave it to the interested reader to compute the levels of the minimum fine in different scenarios.

We start from a benchmark case in which firms are not punished for forming a cartel, even though colluding explicitly remains illegal and, therefore, must form a self-sustained equilibrium. Let π^c denotes the per period collusive profit, $\pi^d = d\pi^c$, with $d > 1$, the profit obtained by deviating from the collusive agreement, and δ the discount factor.[23] We also suppose that both the competitive profit and the profit of a punished deviator are zero. The incentive constraint implies that:

$$\delta \geq \frac{d-1}{d}, \tag{4.3}$$

and we will assume that condition (4.3) always holds.

If the sanction against those firms that enter into the explicit and illegal cartel agreement is the same, irrespective of whether they adhere to the terms of the agreement or deviate, the incentive constraint does not change. In this situation we can only hope to deter cartels by tightening the participation constraint. Can we exploit the incentive compatibility constraint to deter cartels with fines that are below the level that would be required to stop them through the participation constraint? The answer is a big yes. To do so, however, firms that deviate and undercut a collusive agreement should be treated more favorably than those that do not. It is puzzling that, both in the US and in the EU, this factor does not seem to have been taken into consideration in setting fines. In neither of these two jurisdictions defecting from the cartel agreement is deemed an alleviating circumstance.[24]

Let F be, throughout the following discussion, the fine expressed as an absolute financial value rather that as a fraction of the firm's revenue, and F^d the fine imposed on a cartel deviator.[25] The expected profit a firm could derive from

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[23] The discount factor incorporates the probability of cartel terminating because of an antitrust conviction, i.e. $\delta = \frac{1-\gamma}{1+i}$ where γ is the per-period probability of detection and i is the interest rate.

[24] The situation is possibly even worse than this. Indeed, if the fine is computed as a fraction of the affected commerce, a deviating firm would face a more severe sanction since its revenue increases as a consequence of its deviation. This leads to the unintended consequence of making the cartel more stable by relaxing firms' incentive constraint. See Spagnolo (2004, Prop. 1) for a more general result on the optimality of reducing sanctions against a wrongdoer that betrayed his partners even in the absence of a leniency program.

[25] To simplify the exposition, contrary to what we have done in Section 4.2, here we prefer to use the absolute value, F, rather than the percentage value, f. However, the relation between these two values is straightforward as, when $m = 0$, as assumed in this simulation, $F = fqc(1+k)(1-\varepsilon k)$.

participating in the collusive scheme is:

$$\frac{\pi^c}{1-\delta} - \alpha F,$$

which implies that the minimum fine with deterrence effects (given the participation constraint) is:

$$F^* = \frac{\pi^c}{\alpha(1-\delta)}.$$

We assume that a firm prefers to deviate if, by so doing, it gets a payoff at least equal to the collusive payoff. Therefore, the cartel is stable only if

$$\frac{\pi^c}{1-\delta} - \alpha F > d\pi^c - \alpha F^d.$$

From Equation (4.3) it is apparent that legislators and antitrust authorities can use the fining policy to make cartels unstable by either increasing the fine against firms that do not deviate, or by lowering the fine against the deviator(s), or by doing both. However, since our starting point is that the fine F might be too high, we want to know whether we can deter cartels with a fine F less than F^*. The answer is trivial. In principle, if there is no lower bound to the value that F^d can assume, we can reach our policy objective even with no fines against non-deviating firms, provided that we are willing to reward deviators. At this stage it is not important to discuss whether such policy is politically or morally feasible. What is important is to make clear the simple principle that sanctions and rewards are distinct only from a semantic point of view. They are actually two sides of the same coin and if, for some reasons, we cannot raise the penalty against bad behaviors (the stick), we can always make them less attractive by increasing the reward for acting properly (the carrot). Therefore, the real question is to understand what is the minimum fine that must be imposed on deviating firms. In the absence of a full fledged leniency program that restricts benefits to the first applicant the floor consists of simply waiving the fine to the cartel members that defect.[26] If $F^d = 0$ the minimum fine against non-defecting firms with deterrence effects (given the incentive constraint) becomes:

$$F' = \frac{\pi^c[1-d(1-\delta)]}{\alpha(1-\delta)}$$

and is clearly less than F^*. The ratio between F' and F^* is:

$$\frac{F'}{F^*} = 1 - d(1-\delta).$$

The assumption that the cartel would be stable without fines (Equation (4.3)), guarantees that $0 < F' < F^*$. The impact of this policy on the minimum value

[26] Giving a reward to defecting firms would be unfeasible because it would make all firms acting in competitive markets eligible.

Table 4.5: Ratio between the minimum fine with and without leniency/whistleblowing programs.

d	$n = 3$	$n = 4$	$n = 5$
1.00	.063	.043	.033
1.50	.059	.040	.031
2.00	.056	.038	.029
2.50	.052	.036	.027
3.00	.049	.033	.025

of the fine with deterrence effects depends on the value of d and δ, and may be significant.[27]

However, there is still some room for more effective policies by combining the principle outlined above with leniency and whistleblowing programs. Following the proposal made in Spagnolo (2000), we could reward the first firm or entrepreneur that applies to the program bringing sufficient hard information to convict a previously undetected cartel by an amount equal to the fines levied on all its former co-conspirators.

Let $r = (n-1)F$ be the value of the reward. The incentive constraint for a stable cartel becomes:

$$\frac{\pi^c}{1-\delta} - \alpha F > d\pi^c + r.$$

The minimum fine apt to make the cartel no longer viable is:

$$F'' = \frac{\pi^c[1 - d(1-\delta)]}{(1-\delta)(n-1+\alpha)}.$$

The ratio between the minimum fine given the incentive constraint, F'', and the minimum fine given the participation constraint, F^*, is:

$$\frac{F''}{F^*} = \frac{\alpha[1 - d(1-\delta)]}{n-1+\alpha}.$$

Table 4.5 shows the values this ratio can take for different values of n, the number of cartel members and d, the multiplicative factor of profits when a firm deviates, when the probability of detection remains constant ($\alpha = .15$) and that the discount factor (adjusted for the probability of detection) is .9.[28]

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[27] For instance if a firm can double its profits by deviating ($d = 2$) and if the discount factor is .9 the optimal fine against non deviating firm can be reduced by 20%.

[28] If the probability of detection over the entire duration of the cartel is .15, the stationary per-period probability of detection, γ, is the value that solves the equation $1 - (1-\gamma)^t = .15$, where t is the duration of the cartel. If we assume that a cartel lasts five years, then we have $\gamma = .03198$. It follows that a discount factor of .9 implies an interest rate of 7.5%.

The values in Table 4.5, of course, are not intended to provide a practical guide about how to compute the optimal fine. Their limited goal is to prove that the policy we described would greatly reduce the fine that must be imposed on non-reporting firms to obtain a deterrence effect. The value of the minimum fine falls to about 3% of the "Beckerian" value, F^*, for any cartel with at least five members. This means that, considering our initial simulation ($k = .1$), a cartel with five members in a market whose competitive mark-up, m, is zero could be deterred by imposing a fine on non-reporting firms equal to less than 2% of the firms' affected commerce over the entire duration of the cartel and paying a reward to the whistleblower equal to the total collected fine. If the collusive mark-up is higher, say .29, as the median overcharge found by Connor in non-US cartel cases, the minimum fine becomes 4.5% of the affected commerce over the entire duration of the cartel. It is hard to believe that such fines would cause any firm to go bankrupt.

This massive reduction in the optimal fine is entirely driven by the strong effect fines have on the incentives of individual wrongdoers to "betray" their partners and self-report, if they are used to pay a reward for the first reporting party only. This mechanism maximizes the conflict between the objectives of the individual firm/wrongdoer and the group of firms/wrongdoers, making co-operation in the criminal team impossible to sustain.

Moreover, these values underestimate the reduction of the optimal fine that is brought about by an efficient use of rewarding schemes. Indeed, as noted at the beginning, one of the most publicized effects of leniency programs is the increase (real or perceived) in the probability of getting caught. This will tighten the participation constraint, as already pointed out by many commentators, but will also make the incentive constraint more stringent, further reducing the scope for a viable and successful cartel. If, thanks to the leniency program, the probability of conviction over the entire cartel life becomes $\beta\alpha$, with $\beta > 1$, the ratio between the optimal fine with a leniency program that rewards the whistleblower as described above (F^β) and the optimal fine without the leniency program (F^*), becomes:

$$\frac{F^\beta}{F^*} = \frac{\alpha[1 - d(1 - \delta)]}{n - 1 + \beta\alpha},$$

and is lower than F''/F^* for any value of d and n, although the further reduction is modest. One last effect, that the previous literature on optimal fines has not recognized, is that an increase in the probability of conviction reduces the relevant discount factor, once this incorporates, as it should, the probability that the cartel breaks down as a consequence of an antitrust investigation. This brings a further reduction in the fine that makes collusion unfeasible. Let us denote with F_δ^β the optimal fine that takes into account this effect together with all the other described before, with β the proportional increase in the probability of detection over the entire duration of the cartel and with η the proportional increase in the per-period probability of detection, so that $\delta_\eta = \frac{1-\eta\gamma}{1+i}$ denotes the factor firms

use to discount future profits when the leniency program is in place. We have that

$$\frac{F_{\delta}^{\beta}}{F^{*}} = \frac{\alpha[1 - d(1 - \delta_{\eta})](1 - \delta)}{(1 - \delta_{\eta})(n - 1 + \beta\alpha)} \equiv R(\delta_{\eta}).$$

It is immediate to see that

$$\frac{\partial R(\delta_{\eta})}{\partial \delta_{\eta}} = \frac{\alpha(1 - \delta)}{(1 - \delta_{\eta})^{2}(n - 1 - \beta\alpha)} > 0,$$

so that an increase in η, that reduces the value of the relevant discount factor δ_{η}, determines a reduction in the ratio between the optimal fine with and without a leniency/whistleblowing policy. $R(\delta_{\eta})$ identifies the fraction of the original fine, computed in Section 4.3, that deters the cartel formation through the incentive constraint with a well-designed leniency/whistleblower reward policy, once we consider all the effects of this policy discussed in this section. To give an idea of the overall effect of such a policy, consider a case in which the cartel has five members, the initial probability of detection (α) is .15, the initial discount factor (δ) is .9, the expected duration of the cartel is five years, the deviation profits are two times the collusive profits ($d = 2$), and the probability of detection over the entire duration of the cartel doubles ($\beta = 2$),[29] the minimum fine with deterrence effects is .019 of the original optimal one. This means that if such a cartel allows firms to charge a collusive price 10% higher than the competitive price, a fine of 1.15% of the relevant turnover imposed on non reporting firms is sufficient to prevent its formation, provided firms are aware of the leniency scheme. If the same cartel can apply a collusive mark-up of 29%, the minimum fine on non reporting firms with deterrence effects becomes 2.85% of their sales in the relevant market.

4.3.3. Additional deterrence effects and imperfections

The results from these simulations are striking, and yet this is not the end of the story. Besides the deterrence effects captured by the simulations, the protection from fines and "reward" effects (pointed out in Spagnolo, 2000a, 2000b, 2004) and the direct increase in the probability of conviction (pointed out in Kaplow and Shavell, 1994), recent theory has identified at least four other types of potential deterrence effects brought about by leniency and whistleblower programs that we did not consider in our simulations:

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[29] To compute η and δ_{η} note that η is the value that solves the following equation $1 - (1 - \eta\gamma)^{t} = \beta\alpha$, where t is the cartel duration and γ the initial per-period probability of detection. Given the assumption in the text we have that $\gamma = .031981$ and that $\eta = 1.1529$. Then we have that $\delta_{\eta} = \frac{1-\eta\gamma}{1+i}$, where i is the interest rate. Since the other assumptions imply that $i = .075089$, we have that $\delta_{\eta} = .86611$.

- an "improved prosecution effect" (Motta and Polo, 2003), linked to the speeding up of the prosecution generated by the additional information a well-designed and well-implemented leniency program makes available, and the consequent saving in resources which could be reallocated to other inspections, partly captured by the last simulations with increased probability of detection;
- a "protection from punishment effect", which reduces the strength of the market punishment that an undercutting firm faces from its competitors for its defection (see Spagnolo, 2000a, 2004);
- an increase in "the risk of being undercut and denounced" by other firms, linked to the reduction in trust and to the increase in strategic uncertainty determined by the leniency/reward scheme (see Spagnolo, 2004);
- a "rewards for employees effect", which amplifies the incentive and deterrence power of the reward scheme simulated above when each individual employees of a price-fixing firm can cash the reward (see Aubert et al., 2005).

These additional deterrence effects may reinforce the ones included in our simulation exercise, and ensure that its results, in terms of relative reduction of the optimal fine, are far from being unrealistic.

On the other hand, we should not forget that firms, and particularly managers that individually choose to blow the whistle, may face very harsh sanctions from their former business partners, peers, and from the business community in general, that can range from exclusion from the business and social exclusion, to physical harassment. These effects may last for the whole length of the prosecution. This is probably the main reason why, when directed at individuals, only programs with very high expected rewards, like the US False Claim Act, appear to induce informed parties to spontaneously blow the whistle.[30] In addition, wrongdoers may not be well informed about the size of expected fines from being turned in and rewards from self-reporting; and even if they are, they tend to underestimate the probability of being convicted when starting and illegal activity (Camerer, 2003). In the case of international cartels the effect of leniency programs and rewards is also mitigated by the fact that many countries are not subject to antitrust laws (Connor, 2005). All these factors tend—*ceteris paribus*—to reduce cartel deterrence and require fines to be higher than previously calculated, so that direct deterrence is maintained and sufficiently high rewards can be paid to encourage whistleblowing.[31]

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[30] Korea recently introduced a reward scheme for whistleblowers in antitrust cases, but the 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 a tightly knit economic and social network.

[31] The rewards paid out should never be above the sum of the fines paid by the co-conspirators, otherwise there would be an opportunity for firms to "milk the system" and make money by pretending to have a cartel, reporting it, paying fines, and then sharing the reward. This is why we are very far from claiming that fines should be reduced with the introduction of reward schemes for whistle-

4.4. Implementing the optimal fine efficiently

According to previous simulations, when well designed leniency programs and whistleblower schemes are in place a substantial increase in the level of financial sanctions that is likely to remain within the firms' *normal* ability to pay should be sufficient to deter cartels without having to introduce imprisonment. This analysis disproves two arguments in favor of imprisonment: the main one, that financial sanctions on their own are insufficient; and the second one that imprisonment makes indemnification more difficult (if fines are such that firms have no incentives to break the law, firms would never indemnify managers that choose to do so).[32] In this section we discuss some issues related to the implementation of the optimal fining policy. The first issue is how to define firms' normal ability to pay (Section 4.4.1). The second issue is whether individual sanctions are needed when firms can adopt an internal monitoring system (Section 4.4.3). The third issue concerns how firms set their prices when they face a sunk cost, such as a fine (Section 4.4.3). We clarify why most of these issues, that may provide reasons in favor of the adoption of criminal sanctions against individuals, can be also addressed by a fining policy that uses efficiently leniency and whistleblowing programs.

4.4.1. Firms' ability to pay and the problem of judgment proofness

The path breaking work of Summers (1983) and Shavell (1986) stressed how limited liability and senior securities may limit the maximal fine a wrongdoer may be subject to, reducing expected sanctions and, hence, the deterrence effect below the levels chosen by the legislator. This problem of "judgment proofness" is well known in antitrust, and is probably the strongest argument put forward for the use of imprisonment by Werden and Simon (1987). Its relevance and limits have been empirically demonstrated by Craycraft et al. (1997), who showed that US courts do tend to reduce financial sanctions against colluding firms with a lower ability to pay. The latter study, however, also shows that the fines actually imposed are about one/fourth of the maximal applicable statutory fines, that almost all firms in their sample could have easily paid the maximal fines, and that contrary to the pessimistic forecast of Werden and Simon, about half of them could also have paid an optimal cartel-deterring "Beckerian" fine without going bankrupt.

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blowers. Quite the opposite: high monetary fines and rewards are complementary instruments in obtaining efficient deterrence (Spagnolo, 2000a, 2004).

[32] The argument that imprisonment hinders indemnification is anyway rather weak. Mullin and Snyder (2005) elegantly showed that forbidding indemnification costs innocent firms more than guilty ones, reducing deterrence when mistakes are present. The only surviving argument against indemnification is that forbidding it may increase the willingness of firms' employees to cooperate with law enforcement agencies. However, employees' cooperation can also be elicited with rewards, as done by the False Claim Act.

Fines can, and should be substantially increased, both in the EU and in the US, because they are much below the optimal fines, below what most observers regards as firms' maximal ability to pay (the value of total equity), and even below levels that could reduce firms' ability to compete after a conviction.

Fining shareholders to reach "real" ability to pay. There seems to be some confusion about the concept of firms' maximal ability to pay used in the legal and economic literature. A firm's maximal ability to pay is usually taken to be the total "market value" of the firm, measured by the current/normal market price of an individual share times the number of existing shares. This has led many observers to argue (somewhat prematurely) that firms' ability to pay is too low for fines to have any deterrence effect without imprisonment.

However, basic corporate finance teaches us that in public corporations with many shareholders ownership and control are separated, so that dispersed shares incorporate very little 'control rights' on the firm future cash flow, which depresses their price. A firm's market value based on the individual share price times the number of shares—unless the price is picked during a takeover battle for control—is typically a fraction of a firm's *real* market value and, hence, ability to pay, both of which are determined by past, current, and expected future income.

One possible avenue for collecting high fines without causing a firm to become financially insolvent is by forcing it to pay the fine by selling shares with control rights, rather than letting the firm choose how to pay it. The law could establish, for example, that if a firm is convicted for price-fixing, all its shares will be expropriated and sold on the market, and the revenue from this sale used to pay damages and the fine. An analogous way to fine shareholders, less dramatic and possibly easier to implement from a legal point of view, could be to dilute old shareholders' ownership. For example, the law could establish that if a firm is convicted for price fixing (or for another crime), the number of that firm's shares triples, and the new shares—2/3 of total firm shares after the conviction—are sold on the market through a transparent auction. These procedures, aimed at fining shareholders rather than the firm with all its stakeholders, could increase deterrence for at least two reasons:

1. When a firm's shares are sold on the market its control could change hands and a contest analogous to a takeover battle may take place, which may increase share prices and allow the imposition of a fine that is closer to the firm's real ability to pay.
2. Putting a firm's control at stake hits *insiders* (that have control of the firm) much harder than minority shareholders (that have little information and influence on firms' decisions), because insiders risk loosing control on the firm, in addition to the value of their equity stakes. Since insiders that have control are the ultimate decision makers of any corporation, this kind of fine is likely to threaten the right people and induce them to prevent their managers from fixing prices (or committing any other corporate crime).

An additional benefit of a policy of this kind is that, even though the fines are high, it is likely that firms' ability to go on producing and competing is not jeopardized. Firms finance most investment and production through retained earnings and debt, and only in minimal part through equity. A fine on shareholders, of the type described above does not directly affect the firm's earnings, nor its debt capacity, and, hence, has a minimum effect on the firm's ability to invest and produce.

Strategic judgment proofness and extended liability. An apparently less well-known problem in antitrust is that of *strategic* judgment proofing, i.e. of the possibility that cartel members react to an increase in financial fines by issuing more securities senior to the antitrust fines. This problem was raised recently by Che and Spier (2005) in the context of tort law, where damages to victims of accidents are junior claims relative to long term debt, so that long term debt can be used to shield valuable assets from damage claims.

One could think that in antitrust this problem would become relevant, if financial sanction approach firms' current ability to pay, only in those jurisdictions where financial claims senior to administrative fines could be issued.[33] If this was the case, the problem would be of minor importance, as it would be relevant to few jurisdictions, and could be easily solved, for example, by limiting firms' ability to issue senior claims, as suggested by Che and Spier (2005) for tort law. This, however, would be an optimistic stance. First, because there are other, more subtle ways in which the controlling insiders, who are aware of committing a crime and of risking high fines, can hide profits and assets and, thus, reduce their liability (i.e. they can "tunnel" illegal gains out of the liable firm). Second, and most important, because there are "political–reputational" reasons why, even when antitrust fines have priority on other claims, fines that render a convicted firm insolvent towards other stakeholders driving it bankrupt may never be imposed, so that senior fines become effectively junior claims and the judgment-proofness problem may re-emerge. The results of Craycraft et al. (1997), already mentioned, prove that in the US this problem exists. It is plausible to believe that administrative agencies in Europe are even more careful in avoiding to be the source of bankruptcy procedures. We call this additional effect the "political judgment proofness" problem, to distinguish it from the original and the law-induced strategic judgment proofness problem.

Legal and political strategic judgment proofness problems are serious, as colluding firms can avoid harsh fines by appropriately increasing their financial liabilities, distributing all cash flows and financing investment only with debt, or undertaking other inefficient actions. A policy of reducing fines for firms with an apparently lower ability to pay, as followed by US courts, implicit in the EU

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[33] In the US antitrust fines are criminal fines, hence according to Chapter 13 they are not dischargeable in bankruptcy. In several European countries administrative fines are equivalent liabilities towards the state (e.g., taxes), and enjoy priority on most other claims.

guidelines, and often implicitly suggested by some legal scholars (e.g., Wils, 2005b), may end up causing *double* welfare losses: those from reduced cartel deterrence due to firms' strategic reduction in their ability to pay and expected fines; and those linked to the direct, real costs of the inefficient financial structure and other costly practices colluding firms may undertake to reduce their ability to pay and expected antitrust fines.

Among the countermeasures currently discussed to reduce problems of judgment proofness in the context of environmental regulation and tort law there are: setting caps on liabilities that have priority on sanctions or damages (e.g., Che and Spier, 2005); extending liability for damages and sanctions to debt-holders (e.g., Hiriart and Martimort, 2005); and imposing a minimal asset requirement as in banking regulation (e.g., Shavell, 2004). All these instruments limit the negative effects of judgment proofness, but generate also some costs. Extended liability and caps to senior securities make external financing more costly, and minimum asset requirements raise barrier to entry and may, thus, reduce competition. Moreover, they are not likely to help with the problem of political judgment proofness, as with this problem it just matters whether bankruptcy is likely to occur once a high fine is imposed.

An alternative potential instrument—to our knowledge not recently discussed, but worth a serious analysis—is reducing/softening shareholders' limited liability constraint in cases where the liabilities derive from proven illegal conducts. Limited liability is essential to ensure a smooth flow of savings/capital from households and financial institutions to firms. However, there is nothing optimal in ensuring a flow of finance to illegal (albeit profitable) enterprises. *Prima facie*, therefore, it appears that it could be desirable to make a distinction between legal and illegal behavior, and to have a somewhat different degree of shareholders' liability protection, stronger when bankrupt is due to a bad outcome of a legal activity, and weaker when it is due to a discovered and sanctioned illegal activity. This possibility must be scrutinized in depth from a number of points of view, but it appears potentially able to provide investors with incentives to prefer firms whose directors select and monitor their managers and write compensation contracts that are unlikely to lead to illegal behavior.[34]

Of course, the issue is very delicate and needs a careful analysis, not least because the shareholders fined when the cartel is detected/convicted may be different from the shareholders that decided the governance structure, and because shareholders may sell and buy shares during the prosecution stage, so that freezing the trade of the shares of the firms under prosecution may be required. Nevertheless, as we mentioned, *a priori* there seems to be no obvious

[34] With equal limited liability, when facing the choice between a manager known to be good for undertaking very profitable illegal activities without being detected, and a honest manager good at legal but much less profitable projects, profit-maximizing shareholders may well find rational to choose the first option. On the relation between corporate governance arrangements and collusive behavior see Buccirossi and Spagnolo (2006).

justification for granting a perfectly equal degree of protection from liabilities originating from legal and illegal activities.

Not so relevant after all. All these measures entail costs. The latter one could potentially increase the financing costs to all firms, including those that strive to behave legally, given that corporate governance contracts are never perfect and that type I errors (false convictions) cannot be eliminated. The judgment proofness problem, therefore, tends to make imprisonment a relatively more appealing solution. However, one should also take into account that measures that make a firm judgment proof are themselves costly. Overborrowing, for example, distorts the capital structure of a firm, and, therefore, managerial incentives and the firm's cost of financing. Tunneling, i.e. diverting resources out of the firm so that they cannot be reached by law enforcers, entails high transaction costs. This means that high fines, since they induce wrongdoing firms to adopt such behavior and incur such cost, increase the cost of illegal behaviors and, therefore, have partial deterrence effects. Moreover, the costs (and the social cost) of a suboptimal financial structure and other distortions leading to judgment proofness tend to increase at an increasing rate in the "amount" of judgment proofness a firm wants to obtain. This suggests that, when smaller fines are sufficient to deter a crime, as we showed to be the case when well-designed and well-implemented leniency and whistleblower reward schemes are in place, these problems are likely to be of lesser relevance, if any.

4.4.2. Individual sanctions and internal monitoring

Cartels are normally run by top level managers, and appear to be happily tolerated by Board of Directors and large shareholders. Other stakeholders, like minority shareholders, debt-holders or labor unions are typically complacent, if not directly involved in the management of the cartel, as part of the collusive rent tends to "trickle down" in one form or another to all employees and reduce the riskiness of the debtors' claims. This state of affairs should not be surprising. If the expected return of engaging in an unlawful conduct, such as price-fixing, is positive, firms will develop an internal organization that favors this conduct instead of discouraging it. Moreover, as for any rent that accrues to a firm, a collusive rent will be shared among several stakeholders according to their role in the activity or set of activities that give rise to the rent (and their bargaining power). All this is currently reflected in the most common compensation packages for managers—including stock-options—that base pay (and promotion) on short-run profits. Evidence suggests that employees facing these contracts are more likely to commit illegal acts that boost profits in the short and medium term, such as price-fixing, because they gain from the immediate benefit of the act, but do not bear its full cost (see Buccirossi and Spagnolo, 2006).

According to some authors (Werden and Simon, 1987; Polinsky and Shavell, 1993), to remedy this situation, we need sanctions that target directly those in

the organization who are responsible for the illegal agreements. The threat of the sanction should be such as to counter the incentives individuals have to commit a crime, when private incentives are not enough. However, this argument, although intuitively appealing, avoids several intertwined questions that need to be fully understood before it can be accepted.

First and foremost, we need to understand why currently the internal organization of many firms is such that top managers are not adequately dissuaded from forming cartels. This may be due to at least two reasons. The first reason is that firms (shareholders) are not able to effectively monitor and punish managers that undertake illegal activities. The second reason is that firms do not have an incentive to do so. If, as we believe, given the current level of expected antitrust sanctions, at least in the EU firms (shareholders) are better off if they participate in hard-core cartels without deviating from the illegal agreement, then the reason that better explains the pro-collusive internal organization of firms is likely to be the second one. Therefore, before interfering with the way incentives are shaped within firms we should try to change the incentives of the organization so to align them to those of society. Our proposals in the previous sections are aimed at this end.

Second, provided that we have been able to make firms (shareholders) fully internalize the social costs of forming cartels, so that firms (shareholders) and public authorities (assuming that the latter pursue the maximization of social welfare) have the same incentives to trail and punish individuals who set up and coordinate cartels, who is in the best position to do it? Is public enforcement against individuals more efficient than an internal system of monitoring and punishment? This question is crucial because, if an internal mechanism is more efficient, then we should focus only on correcting the payoffs of the organization and not those of individuals that work within it. Polinsky and Shavell (1993), in a context of corporate tort, argue that, as the sanction that the firm can impose on managers is limited, shareholders may not be able to provide them with the correct incentive to exert an efficient level of care to avoid harms for which the firm can be held liable. This justifies the adoption of sanctions directly imposed on employees. However, firms can reward employees for good behavior rather than punish bad one, and if we introduce leniency and rewards to whistleblowers as a public law enforcement instrument, firms can always use them to compensate their managers for reporting the cartel, in which case they do not face the constraint identified by Polinsky and Shavell.

Third, sanctioning those agents who are directly responsible for the illegal act changes not only the incentives of these same agents, but also those of their principals that have the task of monitoring them. Individual liability alone may remove incentives for corporations to monitor crime *ex ante*, as principals, who are responsible for deciding the level of internal monitoring, are not directly penalized.[35] However, as shown by Arlen (1994), a regime of strict corporate

[35] See Instefjord et al. (1998) for an elegant formal analysis.

liability creates a problem of credibility of *ex post* policy measures (i.e. of the actions taken after the cartel has been formed and the responsible manager identified). Internal policing measures reduce expected liability insofar as the responsible manager is actually sanctioned *ex post*. Yet, *ex post* measures increase the probability that public law enforcers detect and sanction undeterred illegal conducts, increasing the firm's expected liability. This makes *ex post* sanctions not credible. The problem, though, arises only if the firms that discover a cartel and report it face a sanction. If reporting is rewarded with amnesty or monetary prizes, the credibility problem of *ex post* policy measures does not exist anymore, making internal monitoring a credible and viable policy instrument.

Our proposals aim at improving firms incentives to behave legally, to monitor its employees and to report misconducts. Imposing fines and providing rewards that affect the value of the firm, make shareholders (i.e. the ultimate principals) responsible for setting up an organization that minimizes the risk of antitrust liability. Directors and top managers will then be selected also for their ability to prevent subordinates from acting illegally, envisaging compensation and promotion policies that do not inadvertently encourage wrongdoing. Moreover, an informed and forward looking stock market might reward those firms that adopt effective compliance programs, as they reduce the risk of the corporate crime liability.

4.4.3. The "sunk cost bias" and optimal antitrust fines

All the literature on optimal fines against cartels in law and economics up to now, at least to our knowledge, is based on the standard rational choice paradigm in which economic agents maximize expected payoffs. Behavioral economics has become a lively field of research in recent years because empirical and experimental regularities in non-rational behavior have been shown to be sufficiently robust to be considered reliable primitives for economic reasoning and modeling.[36] In this section we focus on one particular behavioral regularity of economic agents that may have dramatic effects on the definition of an "optimal fine" against cartels, and on the relative convenience to use imprisonment in addition to fines: the so-called "sunk cost bias".

Experimental work shows that sunk costs affect following behavior, and in oligopolistic environments the unexpected effect of sunk costs is that of increasing following prices.[37] It is not clear whether the observed "sunk cost bias" is

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[36] See Camerer (2003) for both an excellent introduction and an in-depth treatment.

[37] See Offerman and Potters (2005). Their original motivation was the European wave of UMTS spectrum auctions, and some governments' claim that they would prefer to award licenses through a Beauty Contest rather than an auction because the high license fees paid after the auction would lead winning firms to increase prices to recover the license fees, reducing consumer usage and welfare. The argument was readily discharged by many economists, as according to textbook economics sunk costs, like license fees, cannot affect pricing. Under standard forms of competition among profit-maximizing firms, marginal costs determine equilibrium prices and sunk costs do not affect marginal

caused by a form of coordination effects of sunk costs in terms of implicit collusion, to forms of mark up pricing rules used by bounded rational agents, or to a mixture of these effects. Some interpret this finding as agents typically prorating the cost of sunk investment as mark ups on future prices. This bias leads them to price more according to average cost, than to marginal cost. Furthermore, agents do not learn marginal cost pricing through profit and market share losses in repeated competitive situations: Convergence to marginal cost pricing in the long run is obtained only under monopoly, while with oligopolistic competition, agents do not learn "optimal" oligopolistic marginal cost pricing. Al-Najjar et al. (2005) recently developed a theoretical learning model that shows how such a bias may actually persist in an oligopoly, but disappear in a monopoly.[38]

Independently of its roots, this price effect of sunk costs, if really persistent in society, may have important implications for our discussion, and more generally for the theory of corporate law enforcement.

Suppose a cartel is detected, successfully prosecuted and fined by the law enforcement agency, and suppose that, after conviction, a cartel is no longer sustainable—e.g., because the agency and the customers are alerted and sanctions against repeated wrongdoers are higher. After the conviction and the fine payment, the convicted firms, if they are led by profit-maximizing managers, should consider the fine as a sunk cost that does not affect post conviction competitive prices (unless the fine is so high that it affects capital structure of the firms and its marginal cost of financing).

If, instead, convicted firms are led by managers subject to the "sunk cost bias", post conviction competitive prices increase because all managers would simultaneously add a mark up on their costs to recover the fine. If this correctly portrays the firms' behavior after a cartel is convicted, then:

(1) *Ceteris paribus*, fines needed to achieve a given level of cartel deterrence in the absence of leniency or whistleblowers programs would be even higher than those calculated in Section 4.2. This is because the simultaneous increase in competitive prices has a pro-collusive effect that allows firms to recover at least part of the fine. That is, any given fine has a reduced deterrence effect because it helps managers to raise competitive prices and transfer the fine on consumers.

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costs. In such a profit maximizing environment, if a firm deviates from marginal cost pricing it would lose market share and profits, which should lead it to learn optimal pricing. Offerman and Potters showed that the argument was discharged too early, as in their experiment, when licenses are auctioned, prices increase substantially in the following oligopolistic interaction, all firms do pretty well on average, and do not change strategies.

[38] This may seem not at all surprising, given that many business textbooks teach future managers precisely to price according to average cost, and that such a rule may appear intuitively appealing to many unsophisticated agents. Al-Najjar et al. (2005) provide a nice list of business textbooks conveying this message in a number of different and amusing ways.

(2) Higher competitive prices entail lower consumption and the same inefficiency (loss of social surplus) as price fixing. This means that fines are not pure, welfare-neutral, transfers but that they are socially costly to impose, the more the larger they are. This, in turn, implies that Becker's methodology for calculating an optimal fine should *not* be applied to corporations, as it disregards this inefficiency. Taking this inefficiency into account changes the way the optimal fine and the optimal level of fine-driven cartel deterrence should be determined, but it is not clear in which direction. There are at least two conflicting effects. An increase in the level of the fines increases future prices of convicted and prosecuted cartels and the relative inefficiency. This effect points at reducing fines. However, higher fines increases *ex-ante* deterrence, reducing the number of existing, detected and prosecuted cartels and the frequency with which the inefficiency is incurred. This second effect points at increasing the level of the fine.

(3) The sunk cost bias and its consequences, outlined above, is consistent with Sproul's (1993) puzzling and still unexplained empirical finding that colluding firms' prices do not fall after an antitrust conviction. Of course, that finding is also consistent with the hypothesis that the antitrust policy is too mild, and it is not easy to test which of these two explanations is more important.

(4) Because the cost of imposing fines increases while that of imposing non-financial sanctions does not, with the sunk cost bias imprisonment becomes relatively more attractive as a tool to deter cartels and any other corporate wrongdoing.

(5) Leniency and whistleblowers' schemes become even more effective, further reducing the need for high fines and imprisonment. A firm that self-reports first under a leniency program is not fined, while the others are. In the post-conviction competitive interaction, the firm that reported and did not pay a fine will set a lower price than competitors and enjoy an increase in market share and profits. In other words, with the sunk cost bias, leniency determines a post-conviction competitive advantage for the firm that self-reports first. This increases incentives to self-report, and reduces the level of post-conviction competitive prices and the inefficiency linked to higher prices.[39] A reward scheme of the type we have discussed, therefore, could reduce the inefficiency of fines even more. If the first reporting cartel member also enjoys a symmetric "sunk benefit bias" after having received the reward, in the post-conviction phase, it will enjoy or perceive an even stronger competitive advantage and will price even more aggressively than if it had just been granted immunity. This further increases the attractiveness of rewards, their deterrence effects, and lowers the inefficiency generated by the fines

[39] An analogous competitive advantage for cartel members that self-report under a leniency program—caused by the additional costs future rivals face because of remedies linked to antitrust conviction—is considered in a repeated oligopoly model with profit-maximizing firms by Ellis and Wilson (2002).

paid by other firms (who either will have to follow its price downward, or will loose market share so that a smaller fraction of consumers are exposed to inefficiently higher prices). This tends to reduce the need to introduce imprisonment.

(6) Whistleblowers' programs become even more efficient as they further reduce the (costly) financial fine with optimal deterrence properties.

The sunk cost bias, if it is important in the real world as it appears to be from the first experimental evidence available, is likely to have dramatic, but complex, effects on the optimal design of corporate and antitrust law enforcement policy. Understanding in depth these effects and how their interaction affects optimal fines, and the relative cost of fines and imprisonment requires a full-fledged theoretical analysis and more experimental and empirical research, and we must leave it to future work.

4.5. Conclusion

There are four main points the readers should retain after reading this essay. The first one is that past EU fines appear to have been too low to have sufficient deterrence effects. The second is that a different methodology should be used to correctly evaluate the likely deterrence effects of fines when an effective leniency program is in place. In the light of this improved method, current EU fines still appear insufficient, even if the leniency programs was implemented efficiently.[40] The third is that introducing imprisonment is certainly a possible solution to increase deterrence with its costs and benefits, but that well-designed and well-managed whistleblowers schemes could achieve the same result at a lower cost. The fourth is that more empirical and experimental research is needed to understand how to improve the enforcement of antitrust and corporate laws.

Words of caution. Errors cannot be eliminated. Hence, reducing the incentives to act illegally, either with high fines, imprisonment or with a system of fines and rewards, may have the undesired effect of reducing the incentives for firms to behave efficiently if there is a chance that their behavior can be mistakenly judged as illegal.

The legal system is an incentive scheme, and leniency and reward programs for whistleblowers, as well as prison sentences can be seen as "high powered" incentives. Economists are well aware that, if badly designed or badly implemented, high powered incentives can have very negative effects. Hence, leniency and whistleblower programs must be designed and implemented with great care,

[40] Recent empirical work by Brenner (2005) and Arlman (2005) suggests that the 1996 version of the EU Leniency program was not well implemented and therefore not helpful in terms of cartel deterrence.

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otherwise they could generate counterproductive effects, as any other effective policy instrument.

It has been argued that rewards to whistleblowers could increase law enforcement costs by stimulating information fabrication to cash undue rewards. This claim does not seem to be empirically validated by the US experience under the False Claim Act, where very high rewards are paid to informants, and no serious information fabrication problem has, so far, emerged. The False Claim Act, though, is a very well-designed and well-administered program. Badly designed or badly implemented programs could, of course, lead to problems of information fabrication. Still, as argued in Spagnolo (2004), deterring information fabrication is feasible, and should not impede the introduction of rewards.

Nirvana is not yet here. Dworkin and Near (1997), among others, suggest that rewarding whistleblowers may contribute to an environment of mistrust and uncertainty and have negative effects on organizational efficiency. Kobayashi (2002) suggests that in the US we may be already close to overdeterrence, so that strengthening tools against cartels further could lead to higher internal monitoring costs for firms and higher prices for consumers (the US Congress strongly disagreed though, when it steeply increased sanctions against cartels in 2004). Aubert et al. (2005) analyze formally several situations in which firms may decide to adopt inefficient organizational decisions in order to reduce the risk of being convicted for collusion generated by leniency and whistleblowers' scheme. They point out that reward schemes may deter socially desirable cooperation, and show how these schemes may force colluding firms to reduce turnover in order to retain loyal but inefficient employees, or induce them to overinvest to mimic innocent behavior and avoid raising suspicions. However, these are costs that directly increase deterrence and welfare.

To sum up, the deterrence benefits of *carefully designed and implemented* leniency and reward schemes appear to strongly dominate the additional costs these may bring about, and appear able to solve the main problems that caused many to call for criminal sanctions and imprisonment. However, poorly designed and implemented leniency and whistleblowers' reward programs, as poorly administered criminal sanctions, have the potential to substantially harm welfare.

We conclude with a somewhat obvious statement: empirical research on antitrust law enforcement is highly needed! With so many good empirical economists working on fancy, and often policy irrelevant, subjects, will we manage to get some more of them to address policy relevant questions like these ones?

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