ORGANISED CRIME, INSIDER INFORMATION AND OPTIMAL LENIENCY*

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When 'low-rank' criminals are offered to cooperate with justice in exchange of judicial leniency, their information generates *ex post* rents that may actually favour their bosses and increase the crime profitability. Hence, an optimal leniency policy must trade off the positive impact of helpful disclosure of insider information and the positive externality that these rents exert on the organisation's returns from crime. Due to this tension, the amnesty that minimises the probability of crime induces the Legislator to restrict the access to the programme, by excluding informants owning potentially useful knowledge. This result survives to a number of robustness checks.

Successful prosecution of criminal organisations often rests upon the testimonies of cooperating accomplices (whistleblowers). This is because the most culpable and dangerous individuals rarely do the 'dirty job': even if they are ultimately responsible for the crimes committed by their 'soldiers', these people hardly get convicted because they mainly deal through intermediaries and push their own participation up to behind-the-scenes control and guidance, see, e.g. Jeffries and Gleeson (1995).

As a result, many countries have introduced innovative legal rules (leniency programmes) facilitating the use of insider information in criminal proceedings, in exchange of lighter sanctions for criminals who flip and offer their 'help' to justice. The logic of these programmes is based on the divide-and-conquer principle, which has been extensively applied in the IO literature dealing with price fixing, see, e.g. Motta and Polo (2003) and Spagnolo (2008). But, while cartels are horizontal organisations, in which each member (usually) has equal power, criminal organisations are typically hierarchical and base their strength on the ability to punish disloyalty. The testimonies released in trial by low-rank criminals can, indeed, provide a richly detailed context to a case, which can help making the public proceeding against their former heads compelling. However, these people turn informants and cooperate with justice only when the 'deal' they are offered warrants legal benefits that (at least) cover the costs of remaining loyal to the organisation, which tend to be obviously higher when there is more exposure to risk of retribution by their former partners, see, e.g. Schur (1988).

We study a model in which low-rank criminals, who are offered the option to flip and cooperate with justice in exchange of judicial leniency, own insider knowledge that, if

disclosed, can be used by the legal system to convict their former heads. We show that *ex post* and *ex ante* efficiency mandate quite different policies. The *ex post* efficient rule would require low-rank criminals to always blow the whistle, because the probability of convicting their heads is higher with rather than without insider information. Conversely, *ex ante* efficiency may induce the Legislator to purposefully restrict the access to the programme through the choice of an amnesty that does not appeal to all potential informants and, in some cases, even to shut down the programme. This tension is purely due to the Legislator's lack of knowledge about the whistleblowers' insider information: if the Legislator knew this evidence, he would choose a type-contingent amnesty that makes every informant just indifferent between accepting to cooperate with justice and facing the trial. But, this is not feasible when the potential evidence that these criminals may disclose is not known by the judicial authority. The reason is that whistleblowers enjoy an information rent, which tends to worsen deterrence because it reduces the (*ex ante*) wage that they are willing to accept in order to pursue the crime: a dark side of leniency.

The baseline model involves a hierarchical criminal organisation formed by two mobsters that are in a 'principal-agent' type of relationship: a boss and a subordinate. After the crime has been committed, some evidence about the boss's involvement into the crime materialises. This evidence is observed only by the organisation members but not by the judicial authority, and if disclosed it enhances the prosecutors' ability to jail the boss. The crime triggers an investigation and, at this stage, the subordinate can opt to blow the whistle by disclosing all, or only part of his private information.[1] When he does so, the boss will punish his disloyalty: the subordinate will undergo a retaliation loss. The price for cooperation is an amnesty announced by the Legislator at the outset of the game.

We show that, when low-rank criminals own useful insider knowledge about the involvement of their heads into criminal activities, the Legislator must grant rents to whistleblowers in order to elicit such information. These rents increase the expected utility of low-rank criminals, whereby exerting a positive vertical externality on the boss's expected return from crime. The point is that more valuable testimonies imply a higher conviction probability for the boss, whose retribution ability weakens when convicted and jailed. Hence, accomplices with better information enjoy an *ex post* rent that stifles the *ex ante* wage they need to be offered by the boss to accept the illegal deal, thus increasing the overall crime profitability to the detriment of Society. To mitigate such a dark side of judicial leniency, the Legislator is forced to design a policy that purposefully restricts the access to the programme by excluding informants owning potentially useful knowledge: a novel sort of 'rationing' result that hinges both on the hierarchical nature of criminal organisations and on the hypothesis that cooperating criminals own insider knowledge.

Yet, this policy is feasible only if the retribution power of the organisation from which the informant runs away is not too strong, otherwise the Legislator will

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[1] The antitrust debate after Motta and Polo (2003) (see the recent experimental studies by Hinloopen and Soetevent, 2008; Bigoni *et al.*, 2012, among others) clarified that the dark side of leniency is only biting for cartel members that apply for leniency only after the conspiracy has been detected by the investigators. It does not apply, however, to leniency rewarding 'spontaneous' self-reporting, i.e. agents coming out and starting to cooperate without having been first caught by the police. This explains the timing used in the model and confines the policy conclusions to this class of situations.

(optimally) shut down the programme and give up acquiring insider information. This constraint becomes less binding when the penalties inflicted to low-rank criminals grow larger, and when the insider information they provide can be used more productively by the judiciary.

We also find that the Legislator is less interested in restricting the access to the programme when the boss is exposed to a harsher sanction and the subordinate to a smaller retaliation. Interestingly, a reduction of the boss' retribution power can be interpreted as an improvement in the protection effort of the State. This implies a clear policy implication: the introduction of a protection programme may be a necessary condition for a leniency programme to be welfare enhancing. Protecting the whistleblower more intensively reduces his exposure to the risk of being curtailed and thus tends to reduce the bonus required by the 'marginal' type.[2] This allows the Legislator to restrict access to the programme less by choosing an amnesty that induces the subordinate to talk in a larger set of contingencies.

As for the optimal amnesty, we find that it decreases with the ability of the legal system to use the informants' testimonies: when the judiciary can exploit the informant's knowledge better to convict the boss, the subordinate bears a lower risk of retribution and is thus more willing to cooperate. Most interestingly, the optimal amnesty is positively correlated with the boss' sanction. This is because, if the boss is punished more harshly, the Legislator has less incentive to restrict access to the programme, which in turn spurs the amnesty that must be offered to the 'marginal' type.

Finally, we also show that these programmes perform better in terms of prosecution and conviction rates when the heads of the criminal organisations are punished more severely by the judicial system, when the retaliation power of these organisations becomes weaker and, obviously, when prosecutors are more able to use the whistleblowers' insider knowledge. This suggests a novel and non-obvious empirical prediction from our model: in countries where the people who plan and organise criminal activities are punished relatively more harshly, one should expected more prosecutions and higher conviction rates.

Our analysis is related to the literature on organised crime. Traditionally, this literature has stressed welfare comparisons between monopoly and competitive supply of bads, see, e.g. Buchanan (1973) and Backhaus (1979). More recently, Jennings (1984), Polo (1995), Konrad and Skaperdas (1997, 1998) and Garoupa (2000) started to model criminal organisations as vertical structures whose heads need to discipline their subordinates.[3] But, these models have overlooked the role of accomplice-witness programmes as a tool for generating conflict within criminal organisations, which is instead the starting point of our analysis.

Concerning the potential benefits of partial leniency, Buccirossi and Spagnolo (2006) show that a moderate form of leniency can have the counterproductive effect of facilitating occasional illegal transactions. Similarly, Chen and Rey (2007) show that forms of partial amnesty may be optimal in an oligopoly context where the antitrust authority is uncertain about the market characteristics. A key difference between these

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[2] That is, the subordinate that is indifferent between cooperating with justice and remaining loyal to the organisation.
[3] See also Fiorentini and Peltzman (1995), Kugler *et al.* (2005) and Mansour *et al.* (2006).

and our model is that, in our setting, the cost of partial amnesty is directly related to the information content of the testimonies that whistleblowers are willing to deliver and on the effect that this possibility has on the monetary incentives offered by the boss *ex ante*. This feature seems peculiar to the hierarchical nature of criminal organisations.[4]

The idea of applying leniency to criminal organisations builds upon the antitrust law enforcement literature, which started with the pioneering works by Motta and Polo (2003) and Spagnolo (2003), and studies the effects of leniency programmes on cartel formation in oligopolistic markets.[5] In his analysis of optimal corporate leniency programmes, Harrington (2008) shows that a leniency application is acceptable only if the government's case is sufficiently weak, which means that the applicant must satisfy some minimum conditions on the incremental value of his testimony. However, in his framework, the information reported is assumed to be common knowledge. There are few papers that study the role of information disclosure. Silbye (2010), Sauvagnat (2010) and Harrington (2013) all allow for some forms of private information on the probability of conviction when no firm has applied for leniency. [6] In contrast to Silbye (2010) and Harrington (2013), who characterise the equilibrium outcome of the game between the privately informed cartel members, we are more interested in the mechanism design problem connected to the design of an optimal leniency policy in criminal proceedings. Finally, in contrast to us, Sauvagnat (2010) studies an informed principal problem where the authority has private information about the strength of its case and decides strategically whether to open an investigation or not.[7]

1. The Baseline Model

Players and environment. Consider a game between a benevolent Legislator and two members of a (hierarchical) criminal organisation: a boss and his subordinate. The Legislator, having forbidden welfare reducing criminal acts, designs an accomplice-witness (leniency) programme. The crime yields a random (monetary) return $\tilde{\pi}$ that is distributed over the support $[0, \bar{\pi}]$, with cumulative distribution function (c.d.f.) $H(\cdot)$. The boss has full bargaining power and makes a take-it or leave-it offer to the subordinate upon observing the realised crime return. The offer consists of a wage w to be paid after the crime is committed. If the subordinate refuses the offer, the game ends and both criminals enjoy their reservation utility (normalised to 0 without loss of generality).[8]

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[4] By analysing the relation between the optimal design of criminal organisations and the information flow diffused through their echelons, our article also shares common features with Baccara and Bar-Isaac (2008). They consider both vertical and horizontal structures. We focus only on the former type of organisations, but (in contrast to them) we highlight the link between (endogenously designed) leniency programmes and insider information.

[5] See also Rey (2003), Spagnolo (2008), Aubert *et al.* (2006), Chen and Harrington (2007), and Chen and Rey (2007).

[6] See also Feess and Walzl (2004).

[7] The literature on plea-bargaining also shares common features with our article. In these models, the prosecutor that is concerned with achieving the greatest possible punishment, uses plea bargaining as a means to save scarce resources by avoiding taking all defendants to trial (Landes, 1971). More recently, Kobayashi (1992) interprets plea-bargaining as a device through which a prosecutor 'buys information', see also the survey by Gazal-Ayal and Riza (2009).

[8] We analyse the effect of more complex contracts between the boss and the subordinate in the online Appendices.

Information. If the crime is committed, the subordinate (privately) learns a piece of hard information $\theta \in [0, 1]$ that he may disclose to the judicial authority. If disclosed, this information will help to make the case against the boss, i.e. it increases the probability with which the latter is convicted and jailed. As a convention, we assume that more valuable information corresponds to higher levels of θ. The parameter θ distributes according with c.d.f. $G(\theta)$, whose density is $g(\theta)$.[9]

Judicial rules. Once the crime is committed, a trial against the organisation opens.[10] The conviction technology depends on the Legislator's policy and the subordinate's behaviour. Specifically:

(*i*) If the subordinate remains loyal to the organisation, the boss is not prosecuted,[11] while the former is convicted with certainty and bears a sanction f.[12]

(*ii*) If the subordinate blows the whistle, he enjoys an amnesty ϕ and bears a discounted sanction $(1 - \phi)f$, where ϕf is the penalty that is waived by the policy. However, if allowed to talk, the subordinate must decide how much information he will disclose to the judicial authority, that is, he chooses a testimony $t \in [0, \theta]$ to be delivered in trial. This testimony determines the probability of convicting the boss, hereafter denoted by:

$$\Pr[\text{boss}|t] = \rho(t),$$

which is increasing in t: the more information the subordinate discloses, the easier is for the judicial authority to convict and jail the boss.[13]

For simplicity, throughout, we assume that the amnesty ϕ cannot be contingent on θ. In the online Appendices, we show that the Legislator cannot improve welfare by using more complex direct revelation mechanisms.

Intimidation risk and retribution. Criminal organisations seek to punish disloyalty. When they manage to do so, a loss r is inflicted to the whistleblower. Retribution is successful only if the boss is not convicted, which occurs with probability $1 - \rho(t)$. This is with no loss of insights under the hypothesis that the retaliation ability of the boss weakens once he is convicted and jailed. Notice that, not only the boss's ability to retaliate weakens but also it is less in his best interest to enact retribution. Indeed, the primary reason for the boss to harm a former accomplice who turns government

[9] Insider knowledge in criminal proceedings refers not only to information about the identity of the organisation leader, the roots of his main traffics and crimes, but also about the organisation structure, its financial assets, political connections and so on.

[10] The assumption that a trial opens with certainty is a normalisation.

[11] This assumption reflects the idea that enforcement is prohibitively costly without the help of informants. Clearly, if the Legislator could invest a sufficiently large amount of resources in enforcement, there would be no point in introducing a leniency programme, which, as we will show later, may be costly.

[12] The assumption that the boss cannot be prosecuted when the subordinate does not talk is without loss of generality. Similarly, the hypothesis that the subordinate is convicted with certainty when he remains loyal to the organisation is inconsequential: any increase in his conviction probability has the same effect of an increase in f.

[13] The probability of successful prosecution depends not only on the quality of the public testimony, but it may also by affected by many other factors including for example standard of proofs, the ability of the prosecutors to use this evidence in trial, the ability of the boss' lawyers etc. If convicted, the boss bears a sanction s.

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witness is to deter other accomplices from doing so in the future. However, if the criminal activities of the boss are curtailed due to being in jail, he attaches less value to such a reputation and thus a weakened incentive to incur a costly action to maintain that reputation. Hence, the exogenous retaliation loss r is just a convenient shortcut to capture obvious reputational concerns.[14]

Timing. The timing of the game is as follows:

(i) $\tau = 0$–the Legislator commits to an amnesty ϕ.[15]
(ii) $\tau = 1$–the crime return materialises. The boss decides whether to commit the crime. He offers the wage w to the subordinate. If the offer is rejected the game ends. Otherwise, once the illegal act is committed, the wage w is paid and the game proceeds to the next stage.
(iii) $\tau = 2$–the subordinate learns his private information θ. The investigation opens and the subordinate can opt to cooperate with justice. If so, he decides how much information to disclose.
(iv) $\tau = 3$–the trial uncertainty resolves and sanctions (including the retribution loss) are imposed.

The solution concept is Subgame Perfect Nash Equilibrium.

Payoffs. All players are risk neutral. All sanctions will be interpreted as the monetary equivalent of the imprisonment terms, fines, damages, and so forth, to which the criminals expose themselves. The payoffs of the criminals before the trial uncertainty is resolved are as follows. The subordinate's (expected) utility is:

$$w - f(1 - \phi) - [1 - \rho(t)]r,$$

if he blows the whistle and reports t, otherwise it is equal to $w - f$. For any realised π, the boss's (expected) utility is:

$$\pi - w - \rho(t)s,$$

if the subordinate blows the whistle and reports t, and it is equal to $\pi - w$ otherwise.

Assumptions. The Legislator's objective is to minimise crimes. For simplicity, we rule out cost considerations that include, among other things, the cost of leniency and/or the social cost of retaliation: our qualitative insights do not change if these costs are not so large to induce the Legislator to shut down the programme.[16]

In addition, we impose the following five simplifying assumptions:

A1 *The inverse hazard rate $[1 - G(\theta)]/g(\theta)$ is decreasing in θ. This hypothesis is standard in the screening literature.*

A2 *Whenever indifferent between joining the programme and facing the trial, criminals prefer the former option. This is just a convenient tie-breaking condition.*

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[14] In subsection 3.1. we consider a retribution loss contingent on the testimony t.
[15] Commitment is typically recognised as a cornerstone of any form of leniency programme, see, e.g. Hammond (2004, p. 3).
[16] In the online Appendices, we consider a more general social goal that accounts for career and political concerns.

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A3 $\rho(t) = \lambda t$, *with* $\lambda \leq 1$.

Linearity of the conviction technology simplifies the analysis and does not involve loss of insights. The parameter λ *will be interpreted as a measure of the prosecution ability of the judicial authority.*

A4 *No rewards:* $\phi \in [0, 1]$.

This assumption implies that the subordinate cannot enjoy (monetary) rewards from cooperating with justice, which may reflect legislative constraints due to political and ethical concerns.[17]

A5 *When the subordinate cooperates with justice he fully discloses what he knows, i.e.* $t = \theta$.

Since the evidence observed by the subordinate is hard information (once disclosed), a whistleblower cannot make up additional information over and above what he has learned at stage $\tau = 2$. Moreover, even though in principle he might under-report by delivering a testimony t that falls short of his true knowledge θ, it is simple to show that this is never the case.[18]

1.1. *Equilibrium Analysis*

In this subsection, we characterise the equilibrium of the game and the optimal policy announced by the Legislator. Given the amnesty ϕ announced by the Legislator at stage $\tau = 0$, the state of nature in which the subordinate is indifferent between blowing the whistle and facing the trial (hereafter θ^*) is pinned down by the following condition:

$$(1 - \phi)f + (1 - \lambda\theta^*)r = f \quad \Leftrightarrow \quad \theta^* \equiv \frac{r - \phi f}{\lambda r}. \tag{1}$$

As a result, the subordinate is willing to cooperate only when he has enough information to disclose, i.e. $\theta \geq \theta^*$. By contrast, when he is poorly informed, the danger of being curtailed may overcome the positive impact of enjoying the amnesty ϕ. Note that, other things being equal, the subordinate is more willing to talk if the judicial system is able to use his insider information more productively (i.e. when λ increases), if the retaliation ability of the boss is weaker (i.e. when r drops), when the Legislator is more lenient (i.e. when ϕ increases) and when the sanction is harsher (i.e. when f increases).

Assuming that $\theta^* < 1$, a conjecture that will be verified *ex post*, using condition (1) it is possible to show that the reservation wage that the subordinate must be offered in order to be willing to undertake the crime is:

$$w(\theta^*) \equiv f + \int_{\theta^*}^{1} \lambda r(\theta^* - \theta) \mathrm{d}G(\theta).$$

Similarly, the boss's expected sanction at stage $\tau = 1$, i.e. before θ realises, is:

$$p(\theta^*) \equiv \int_{\theta^*}^{1} \lambda\theta s \mathrm{d}G(\theta).$$

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[17] In the online Appendices we study an extension of the baseline model where rewards are needed to deter crime.

[18] The reason is that, when admitted into the programme, the subordinate is better off if the boss is convicted and jailed, as otherwise he would be curtailed and the probability that this event occurs is decreasing with his testimony t.

As a result, the crime is committed if and only if its monetary benefit exceeds the implied (expected) costs, i.e. as long as the following condition is met:

$$\pi \geq w(\theta^*) + p(\theta^*). \tag{2}$$

Hence, in order to minimise the *ex ante* probability of crime, i.e. $\Pr[\pi \geq w(\theta^*) + p(\theta^*)]$ – the Legislator chooses θ^* to maximise the right-hand-side of (2) subject to $\theta^* \geq (r - f)/\lambda r$.[19] Differentiating with respect to θ^* (see Appendix A), the first-order necessary and sufficient condition for an interior solution is:

$$s\theta^* - \frac{1 - G(\theta^*)}{g(\theta^*)} r = 0. \tag{3}$$

The interpretation of this condition is as follows. Expanding the set of reporters (i.e. reducing θ^*) by means of a more generous amnesty strengthens the prosecutors' ability to convict the boss: a negative (welfare enhancing) externality that a whistleblower imposes on his former boss. At the same time, committing to a more lenient amnesty has also a dark side insofar as it increases the rent of the infra-marginal types (i.e. $\theta > \theta^*$), thereby reducing the reservation needed to induce the subordinate to join the criminal organisation. In a sense, the discount in fines helps matching the participation constraint of the subordinate, reducing the burden on the boss. This is because, for any amnesty ϕ promised by the Legislator, the subordinate enjoys an 'information rent' when his insider knowledge is of good enough quality. That is, his (indirect) utility of cooperating with justice,

$$-(1 - \phi)f - (1 - \lambda\theta)r,$$

is increasing in θ. This implies, in turn, that at the stage in which the wage is offered, the boss internalises the positive impact of such rent on the subordinate's expected utility and pay him less accordingly. Obviously, this lower wage translates onto a higher return from crime, thereby weakening deterrence and thus reducing welfare: a positive (crime enhancing) externality that a whistleblower imposes on his former boss. Notice that, as long as the boss's retribution power drops, i.e. as r becomes smaller, the subordinate's information rent tends to vanish, so that all 'types' could be attracted at a relatively low amnesty.[20]

In a sense, the presence of a dark side is somewhat analogous to the cost of leniency in antitrust, highlighted in Motta and Polo (2003), and is the reason why it is argued that leniency programmes should not be introduced if competition authorities have sufficient resources to invest in prosecution activities.

In the next proposition, we study how the tension between the effects discussed above shapes the optimal policy.

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[19] This constraint simply reflects Assumption A4, i.e. $\phi \leq 1$.

[20] In the contract theory, jargon condition (3) represents the Legislator's 'virtual surplus': the first term captures the negative externality that the marginal type θ^* imposes on the boss by means of his testimony, which obviously enhances welfare; the second term measures the positive impact of the whistleblower's rent on the boss's expected return from crime, which worsens deterrence and thus reduces welfare, i.e. the inverse hazard rate $[1 - G(\theta^*)]/g(\theta^*)$ measures the mass of types that enjoy this rent when the optimal amnesty is such that type θ^* is just indifferent between blowing the whistle and facing the trial. In the online Appendices we show that this trade-off also shapes the optimal direct mechanism.

PROPOSITION 1. *A leniency programme is viable only if:*

$$r \leq r^* \equiv \frac{f}{1 - \lambda}. \tag{4}$$

In this region of parameters the Legislator's problem has a unique (interior)[21] optimum such that the subordinate applies to the programme if and only if $\theta \geq \theta^*$, with $\theta^* \in (0, 1)$ being the unique solution of (3) *and*

$$\phi^* = (1 - \lambda\theta^*)\frac{r}{f} \leq 1. \tag{5}$$

Condition (4) implies that granting amnesties to low rank criminals willing to disclose useful knowledge about their former partners is a viable option for the Legislator only if these people belong to organisations with relatively low retaliation power, i.e. when $r < r^*$. This is because criminal organisations that are particularly violent, and expose disloyal members to serious dangers, are able to undo the effect of the policy through the threat of retribution. By inspection of condition (4), it is easy to conclude that the region of parameters where the introduction of a leniency programme is viable expands when low-rank criminals face a higher sanction (i.e. when f grows larger) and when the judicial system is able to use their insider information more productively (i.e. when λ grows larger).

The optimal policy trades off the bright and the dark sides of granting sanction discounts to low-rank criminals willing to cooperate with justice. As a result, not all potential informants join the programme, even if their testimony would be potentially helpful to convict the boss. That is, even though *ex post* efficiency would mandate an unrestricted access to the programme since $\rho(\theta) \geq 0$ for any $\theta \in [0, 1]$, from an *ex ante* point of view, it is efficient to restrict the access to the leniency programme so as to balance out the tension between the bright and dark side of the policy.[22]

In the next Proposition, we perform a comparative statics analysis that emphasises how the optimal policy responds to the model's underlying parameters. As we will argue in Section 2, some of these predictions are consistent with the available empirical and anecdotal evidence.

PROPOSITION 2. *Suppose that $r < r^*$. The optimal policy has the following features:*

(*i*) *The threshold θ^* is decreasing in s and increasing in r.*
(*ii*) *The amnesty ϕ^* is decreasing in λ and f, and increasing in s. The impact of r on ϕ^* is ambiguous, that is:*

$$\frac{\partial \phi^*}{\partial r} \geq 0 \quad \Leftrightarrow \quad 1 - \lambda\theta^* \geq \lambda r \frac{\partial \theta^*}{\partial r}.$$

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[21] It can be checked that a sufficient condition for an interior solution is $r - f \leq \varepsilon$, with $\varepsilon \geq 0$ and small enough.

[22] Clearly, the fact that the programme is not restricted in the first-best hinges on the assumption that the objective function of the legislator incorporates only the minimisation of crime (and not, for example, the cost of leniency, or the social cost of retaliation). Even if these aspects were taken into consideration, it would be still true that there is less entry in the second best relative to the first best.

Inducing more entry into the programme (i.e. setting a lower θ^*) increases the probability of convicting the boss and it is obviously more effective when the sanction for the boss (s) is more severe, which amplifies the welfare enhancing externality that the whistleblower imposes on the organisation. Conversely, a stronger retaliation power (as measured by an expansion of r) spurs the dark side of the leniency programme; that is, inducing more entry into the programme is less efficient when larger rents (as implied by a higher loss r) translate into a lower wage that the boss has to pay to the subordinate, amplifying the crime enhancing effect of the policy. Interestingly, a reduction of r can be interpreted as an improvement in the protection effort of the State. This implies that the introduction of a protection programme may be a necessary condition for a leniency programme to be welfare enhancing, especially when dealing with strong criminal organisations that are committed to punishing disloyalty of their members severely. Protecting the whistleblower more intensively reduces his exposure to the risk of being curtailed, and thus, *ceteris paribus*, tends to reduce the bonus required by the indifferent type. This allows the Legislator to restrict the access to the programme less, by choosing an amnesty that induces the subordinate to talk in a larger set of contingencies.

Note that by (1) it can be easily inferred that there is a one-to-one mapping between the amnesty rate ϕ and the threshold θ^*. Combined with the optimality condition (3), this implies that while the parameter λ does not affect the states of nature where the subordinate blows the whistle, i.e. θ^* evaluated at the optimal amnesty ϕ^*, it has a direct impact on the optimal amnesty. Specifically, a larger λ tends to reduce ϕ^* because when the judicial system can better exploit the informant's knowledge to convict and jail the boss, the subordinate bears a lower risk of retribution (everything else being equal). In turn, this makes it easier for the Legislator to attract the subordinate with relatively lower amnesties. A larger f also reduces ϕ^* because the higher the subordinate's sanction when convicted if he remains loyal to the organisation, the lower his outside option is, and hence the smaller is the amnesty he has to be offered as a price for cooperation. An interesting result of our model is that the agent's optimal amnesty is positively correlated with the boss' sanction s. This is because, as explained above, a larger sanction s induces the Legislator to ration the access to the programe less, which in turn spurs the amnesty that must be offered to the marginal type θ^* that is now exposed to a higher risk of retaliation. This may explain way many prominent prosecutors, such as Giovanni Falcone and Paolo Borsellino for instance, who strongly supported the introduction of a leniency programme in Italy, also favoured the introduction of article 41-bis of the Prison Administration Act, known as Italy's 'hard prison regime', which is usually applied to mafia bosses and is intended to suspend some of their basic rights (e.g. the possibility of communicating with their relatives and close friends, as well as with other prisoners).

The impact of a stronger retribution power of the organisation on the optimal amnesty ϕ^* is ambiguous. On the one hand, a larger r, *ceteris paribus*, increases the retaliation loss of the subordinate, who will thus demand a more generous amnesty to disclose his private information. On the other hand, a larger r also expands the set of the states of the world in which the subordinate remains loyal to the organisation, and, *ceteris paribus*, this reduces the probability of being curtailed for the marginal type θ^*, who will thus demand a lower amnesty. Interpreting again a lower r as a more efficient

protection programme, it should be noted that an improvement in the State's protection effort does not necessarily lead to lower amnesties: the reason is that the positive impact of protection on the retaliation risk might be counterbalanced by the effect of a less intense 'rationing', which by reducing the indifferent type leads to higher amnesties other things being equal.

Finally, it is useful to notice that the *ex ante* probability of convicting the boss,

$$\int_{\theta^*}^1 \lambda\theta \mathrm{d}G(\theta),$$

is increasing in λ and s, and decreasing in r. This implies that a peculiar and non-obvious testable prediction of our model is that, *ceteris paribus*, it should be relatively easier to convict the heads of criminals in countries where their crimes are punished more harshly (i.e. when s grows larger).[23] The positive correlation between the probability of convicting the boss, the efficiency of the judicial system and the introduction of a leniency programme is, instead, widely documented by Acconcia *et al.* (2014).

2. Institutional Setting and Corroborating Evidence

In this Section, we discuss the main legislative provisions approved to facilitate witnesses cooperation in organised crime investigations and summarise some empirical and anecdotal evidence that supports the model's results.

Measures for cooperating accomplice witnesses. The use of insider information in criminal proceedings is usually debated both on efficiency and fairness grounds. In Germany, for instance, arguments against leniency programmes are based on 'the principle of equal treatment and principles of proportionality and legality' (Huber, 2001). In other countries, like those of Anglo-Saxon tradition, the necessary role played by accomplice witnesses is well acknowledged, especially when a state of emergency is justified because of organised crime. However, the efficiency of these programmes cannot be taken for granted, thereby calling for more empirical research on this ground, see, e.g. Acconcia *et al.* (2014) for a study of the Italian experience.

Nevertheless, while assessing the efficacy of these policies is an empirical matter still under debate, a judicial system that values the quality of the evidence provided in exchange for reduced sentences will certainly punish less harshly leaders of criminal organisations. In other words, as explained by Fyfe and Sheptycki (2006, p. 18): 'creating an environment in which providing "substantial assistance" is the main way informant witnesses get reduced sentences may generate a range of "unfair results". It risks the so-called "cooperation paradox" whereby "kingpins" receive lower sentences than their underlings because the "kingpins" have more information to exchange for a "substantial assistance" recommendation' (p. 18). This feature is consistent with our 'rationing' result stating that only whistleblowers with insider information of sufficiently high quality can (will) apply for leniency.

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[23] For a characterisation of our results and more comparative statics with a closed-form solution see the online Appendices.

Dark side of amnesties. Practitioners and criminologists recognise the existence of a dark side of leniency. For instance, Kelly *et al.* (1994, p. 501) argue that witness protection and immunity for criminal informants 'represents an exit strategy for career criminals'. Citing data from the US General Accounting Office (GAO), Albanese (1996, p. 195) observed that approximately 21% of protected witnesses were arrested within two years of being put on the programme. According to Dunningham and Norris (1996*a*, *b*, 1999) negative consequences of leniency abound crime is facilitated as well as repressed; criminals are licensed to commit crime rather than apprehended for their violations' (1996b, p. 457). Our model highlights a novel potential drawback of these policies.

The witnesses protection programmes. The first and better known witness protection programme is the US Federal Witness Security Program, which was established by the 1970 organised Crime Control Act following the Justice Department failure in the fight against Italian-American organised crime in the 1960s. Since then, many other countries have adopted a witness protection programme as a key tool against organised crime and terrorism. Despite some discrepancies due to country specific legal traditions and to differences in nature and scale of organised crime, the eligibility criteria and the forms of protection are very similar across these programmes: 'The witness needs to be giving evidence in relation to the most serious crimes and those who are close to the witness who might be endangered are also eligible for protection. The forms of protection available are also quite similar and normally involve the relocation of a witness and his/her close family, the possibility of formally changing their identity and help with social and economic assimilation in the communities to which they are moved' (Fyfe and Sheptycki, 2006, p. 5). In Germany, for instance, a person is eligible for protection if she/he is crucial to criminal proceeding and face serious danger if they testify (the 2001 Witness Protection Harmonisation Act). In the UK, a protection provider must, between other things, have regard to: the nature and extent of the risk to the person's safety, the cost of the arrangements, and the importance of his being a witness in those proceedings (the 2005 Serious organised Crime and Police Act ch.4, 82). The importance attributed to the extent of the risk of retribution corroborates the comparative statics stated in Proposition 2 suggesting that protection may be a necessary condition for a leniency programme to enhance welfare, especially in the presence of strong criminal organisations that are committed to punishing disloyalty of their members severely.

Empirical evidence from organised crime leniency. Acconcia *et al.* (2014) show that some predictions of the theoretical model developed above appear to be corroborated by the evidence available for Italy. Indeed, consistent with this evidence, our model predicts a positive correlation between the number of crimes (deterrence), the probability of convicting the boss and the introduction of a leniency programme. Concerning the optimality of using a leniency programme, Acconcia *et al.* (2014) show that the Italian leniency programme engendered a noticeable reduction of mafia related crimes. Moreover, they document an increasing trend in prosecution rates of mafia related crimes, a pattern that is not present when looking at prosecution rates of similar but not mafia related crimes for which a leniency programme is not available. They also argue that the leniency programme creates a shift of prosecutions towards higher ranks of the organisation, when a subordinate talks, the boss is more likely to fall. This result

motivates our assumption that the testimony of the subordinate determines the probability of convicting the boss. Most importantly, they provide evidence that the criminal incentive to cooperate is related to the local legal environment. In particular, variations in the proportion of acquittals in mafia trials (a measure of judicial efficiency) are exploited to reveal any impact of the perceived probability of being convicted on the number of whistleblowers. This evidence is consistent with the fact that θ^* is decreasing in λ, which means that the subordinate is willing to talk if the judicial system can use his insider information more productively.[24]

Empirical evidence from corporate leniency. Although the deterrence effects of antitrust policies are difficult to evaluate, exactly like leniency programmes meant to fight organised crime, indirect methods developed by Brenner (2009), Harrington and Chang (2009) and Miller (2009), among others, address this problem. These papers identify empirically the effects of antitrust policies using changes in observables such as the number of detected cartels or their duration. For a sample consisting of 61 cartel cases investigated and prosecuted by the European Commission between 1990 and 2003, Brenner (2009) does not find evidence that cartels become more fragile after adoption of the leniency programme. Conversely, Miller (2009) shows that the introduction of the US leniency programme in 1993 led to a substantial increase in the rate of detection and decrease in the rate of cartel formation. This difference in the level of deterrence between the US and the EU is in line with the prediction of our model that conviction should be relatively easier in countries where crimes are punished more harshly. Recall that in our model the region of parameters where the introduction of a leniency programme is viable expands as crimes are punished more harshly (Proposition 1). The comparison of the previous papers is therefore a good test of our theory. In fact, while forming a cartel in the US is a criminal offence for which individuals can be subject to severe prison sentences, in Europe managers do not face this threat.

3. Extensions

In this Section, we study two natural extensions of the baseline in which:

- (*i*) the retribution loss depends on the whistleblower's testimony; and
- (*ii*) the organisation is composed by one principal and many subordinates who can damage each other (in addition to the boss) through their testimonies.

3.1. *Retribution as a Function of Testimony*

In A5, we assumed that the subordinate always fully discloses his information when cooperating with justice, i.e. $t = \theta$. This is without loss of generality when the

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[24] Note that the optimal policy characterised in the baseline model is such that the set of contingencies in which the subordinate blows the whistle is not affected by λ, i.e. when evaluated at the optimal amnesty ϕ^*, the threshold θ^* is unresponsive to λ. However, there is no reason to believe that this optimal policy is implemented in practice, which suggests that the negative relation between θ^* and λ is likely to be found in the data at any given ϕ different from ϕ^*.

retribution loss is constant. However, obvious reputational concerns may lead the boss to retaliate more harshly on whistleblowers that publicly disclose more information. Accordingly, we now assume that the retribution loss varies with the testimony t: say r (t), with $r'(t) > 0$. Hence, when the subordinate decides to cooperate with justice, his testimony minimises the expected retribution loss, that is:

$$t^*(\theta) = \arg\min_{t \leq \theta}(1 - \lambda t)r(t).$$

Differentiating with respect to t, in an interior minimum it must be:

$$\lambda r(t) - (1 - \lambda t)r'(t) = 0, \qquad (6)$$

whose solution ($\hat{t}$ hereafter) is unique if $r(\cdot)$ is sufficiently convex and does not depend on θ.

Consider the most interesting case in which there is no full-information disclosure, i.e. $\hat{t} \in (0, 1)$.[25] In this case the optimal disclosure rule is:

$$t^*(\theta) = \min\{\theta, \hat{t}\}.$$

Hence, it is easy to show that the whistleblower's utility is weakly increasing in θ and reaches its (constant) maximum when $\theta \geq \hat{t}$, that is:

$$\max_{\theta \in [0,1]}\{-(1 - \phi)f - [1 - \lambda t^*(\theta)]r[t^*(\theta)]\} = -(1 - \phi)f - (1 - \lambda\hat{t})r(\hat{t}).$$

This implies that an equilibrium in which the access to the programme is rationed can exist if, and only if, the marginal type, denoted again θ^*, is lower than the cut-off $\hat{t}$.[26] Otherwise, either all types will always remain loyal to the organisation, or they will all blow the whistle. In what follows we conjecture that $\theta^* \leq \hat{t}$, and will then verify that the optimal policy satisfies this conjecture. Following the logic developed before, it is possible to verify that the Legislator solves the following maximisation problem:

$$\max_{\theta^* \in [0,\hat{t}]}\left\{-(1 - \lambda\theta^*)r(\theta^*)[1 - G(\theta^*)] + \int_{\theta^*}^{\hat{t}}(1 - \lambda\theta)r(\theta)\mathrm{d}G(\theta) + \int_{\theta^*}^{\hat{t}}\lambda\theta s\mathrm{d}G(\theta)\right\}.$$

Differentiating with respect to θ^*, in an interior solution we have:

$$s\theta^* = \frac{1 - G(\theta^*)}{g(\theta^*)}\left[r(\theta^*) - \underbrace{\frac{1 - \lambda\theta^*}{\lambda}r'(\theta^*)}_{\text{Rent–saving effect}}\right], \qquad (7)$$

where (6) implies $\theta^* < \hat{t}$. Relative to the baseline model, the dark side of leniency, i.e. the right-hand side of (7), is now weakened by a new countervailing rent-saving effect,

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[25] Indeed, when $\hat{t} \leq 0$ nobody will ever want to talk, while if $\hat{t} \geq 1$ there is again full-information disclosure as in the baseline model.

[26] Note that with a retribution loss contingent on t, the indifference condition (1) is rewriten as:

$$(1 - \lambda\theta^*)r(\theta^*) = \phi f.$$

which tends to induce less rationing. This effect hinges on the following logic. When retribution depends on testimony, the types that are exposed to a (relatively) stronger retribution are the intermediate ones, i.e. $\theta \in [\theta^*, \hat{\imath}]$, who fully disclose their insider knowledge. Hence, the Legislator is able to save on the rents granted to all types above $\hat{\imath}$ because they do not disclose all the information they own and are those who enjoyed higher rents in the baseline model where $r'(\cdot) = 0$.

3.2. *Multi-agent Organisations*

In this subsection, we extend the previous analysis by considering a multi-agent organisation. The objective is to study how the vertical externalities discussed above interplay with the horizontal externality that arises when two or more peers can report information that can damage each other in addition to the boss. Suppose that the boss hires N subordinates who commit the same crime, each yielding a common monetary return $\tilde{\pi} \in [0, \bar{\pi}]$. At stage $\tau = 2$ each subordinate i receives information θ_i about the boss, which is again a random variable with support $[0, 1]$ independently and identically distributed with c.d.f. $G(\theta_i)$ and p.d.f. $g(\theta_i)$.[27]

We assume that when more than one subordinate rushes to the courthouse, the amnesty is granted only to the one that has provided the most valuable evidence. In order to capture the horizontal externality between subordinates, we slightly modify the baseline model by assuming that:

(*i*)   if none of the subordinates cooperate with justice, each of them is convicted with probability $\alpha < 1$; and

(*ii*)   if at least one subordinate blows the whistle, all his peers are convicted with probability 1.

All other assumptions are as in the baseline model.

Consider a (symmetric) cut-off equilibrium in which all types above θ^* blow the whistle, while all those below this value remain loyal to the boss. Assuming that $\theta_i \geq \theta^*$, subordinate-i's expected utility from blowing the whistle is:

$$-G(\theta_i)^{N-1}[(1 - \phi)f + (1 - \lambda\theta_i)] - [1 - G(\theta_i)^{N-1}]f,$$

where the $G(\theta_i)^{N-1}$ is the probability that no other subordinate has better information than i, and $1 - G(\theta_i)^{N-1}$ is the probability that at least one other whistleblower has better information than i. Subordinate-i's expected utility of remaining loyal to the boss is, instead,

$$-[1 - G(\theta^*)^{N-1}]f - \alpha G(\theta^*)^{N-1}f,$$

where the conviction probability drops from 1 to α when nobody blows the whistle.

The cut-off (indifference) point θ^* is now:

$$\theta^* = \frac{(1 - \phi - \alpha)f + r}{\lambda r}.$$

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[27] For robustness purposes, in the online Appendices we study the opposite case in which agents own exactly the same information.

Assuming as usual that $\theta^* \in (0, 1)$, the symmetric break-even wage $w(\theta^*)$ is:

$$\int_{\theta^*}^1 \{G(\theta)^{N-1}[f\alpha + \lambda r(\theta^* - \theta)] + [1 - G(\theta)^{N-1}]f\} dG(\theta) + fG(\theta^*)[1 - G(\theta^*)^{N-1}(1 - \alpha)].$$

In order to determine the boss' expected sanction, recall that in this version of the model there may be more than one subordinate willing to blow the whistle. Since we assumed that only the subordinate with the best information will be allowed to testify, let us define:

$$\theta_{max} \equiv \max\{\theta_1, .., \theta_i, .., \theta_N\},$$

as the best available insider information. Since types are i.i.d., $\Pr[\theta_{max} \leq x] = G(x)^N$. Hence, the boss' expected sanction $p(\theta^*)$ is:

$$\int_{\theta^*}^1 \lambda x s d G(x)^N.$$

In equilibrium there will be crimes if, and only if, $N\pi \geq Nw(\theta^*) + p(\theta^*)$. In order to minimise the *ex ante* probability of crime, the Legislator then solves the following maximisation problem:

$$\max_{\theta^* \in [0,1]} \left\{ w(\theta^*) + \frac{p(\theta^*)}{N} \right\},$$

subject to $\theta^* \geq (r - f)/\lambda r$.

The first-order condition for an interior maximum is:

$$s\theta^* + \underbrace{\frac{(N-1)(1-\alpha)f}{\lambda}}_{\text{Courthouse−raceeffect}} - r\frac{\int_{\theta^*}^1 \left[\frac{G(\theta)}{G(\theta^*)}\right]^{N-1} dG(\theta)}{g(\theta^*)} = 0. \qquad (8)$$

This condition highlights how the presence of multiple agents modifies the trade-off between the bright and the dark-side of leniency.[28] The first term again captures the positive vertical externality that whistleblowers impose on the boss, i.e. when the marginal type θ^* increases, the boss' expected sanction becomes higher, weakening his propensity to breach the law. The second term reflects the negative horizontal externality that a reporting subordinate imposes on his peers. This externality, the so-called 'rush to the courthouse' effect, is not novel in the antitrust enforcement literature and is what the Department of Justice's Hammond's many public statements in recent decades and experiments (Bigoni *et al.* (2012) among others) suggest as being the most important benefit of leniency in antitrust: its ability to induce cartel members to self-report and betray their partners for fear of being otherwise betrayed by them. In our model, this effect lines up with the vertical externality highlighted in the baseline analysis, by making the bright side of leniency stronger. Interestingly, this effect is magnified when the size of the organisation grows larger (i.e. when N increases) and

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[28] As in the baseline model, it can be shown that the solution of the Legislator's problem is in fact interior as long as $r - \alpha f \leq \varepsilon$, with $\varepsilon \geq 0$ and small enough.

when the judicial system becomes less efficient in prosecuting criminals (i.e. when α and λ decrease). Notice, however, that the dark side of leniency also changes when there are multiple subordinates. This is reflected by the impact of N on the third term of the above first order condition which increases relative to the baseline scenario. This is because the larger the size of the organisation is, the lower the probability of getting the amnesty is. Hence, the information rent must compensate whistleblowers for this extra risk, which again shifts onto a lower break-even wage, thereby increasing the boss' propensity to breach the law. This suggests that, overall, the effect of the organisation size on the policy is ambiguous and depends on the underlying parameters. For example, when λ is small, i.e. when the ability of the judicial system to use insider information is weak, it is likely that for large organisations the dark side of leniency will be highly diluted and dominated by the positive preemptive force, so leniency should not be rationed, i.e. condition (8) yields a corner solution $\theta^* = 0$. By contrast, for small criminal organisations, e.g. bilateral corrupt exchanges between a bribe giver and a bribe taker, the dark side may bite, and even dominate if α is not too small, so that leniency may have to be rationed, i.e. $\theta^* > 0$.[29]

4. Concluding Remarks

The use of insider information in criminal proceedings is widely recognised as one of the most effective tools in the modern fight against organised crime. Yet, the implementation of these rules is often challenged by ethical concerns. This scepticism calls for a better understanding of the right responses of the judicial system to the growing organisational complexity of criminal groups. To make a step forward in this direction, we study the problem of a Legislator designing immunity for privately informed whistleblowers. Focusing on a hierarchical criminal organisation, we capture the basic trade-offs emerging when the efficacy of a leniency programme is undermined by the natural asymmetry of information between prosecutors and criminals willing to testify against their former partners in exchange of lighter sanctions. Our key finding highlights a novel dark side of leniency programmes. Because informants own insider knowledge (that is only partially verifiable by prosecutors) the policy that minimises crime must restrict the access to the programme because whistleblowers owning particularly decisive evidence enjoy a rent from cooperation that enhances the organisation's propensity to break the law.

The model's predictions are consistent with a number of legal provisions characterising accomplice-witnesses regulations across the world. They suggest that the benefits of these programmes in terms of reduced crime may justify, at least from an efficiency point of view, the recognition of legal benefits to cooperating accomplices whose testimonies can turn particularly useful to prosecute their heads and former partners. Yet, since the optimal policy also requires a selective admission process (rationing), the model confers a scientific argument in favour of those arguing that amnesties should not be granted with ease.

The trade-off between the dark and the bright-side of leniency is robust to a number of extensions of the baseline model. In the text, we highlight only the most interesting

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[29] We are grateful to an anonymous referee for pointing this out.

ones, i.e. the case in which whistleblowers are curtailed according to their public testimony and that in which the organisation is composed by one principal and many subordinates who can damage each other through their testimonies. More extensions are discussed on the online Appendices. The analysis is extended to the case where the benefit of an amnesty is also awarded to a 'self-reporting' boss, i.e. when the boss is induced to confess his involvement in the crime and his testimony enables conviction of the subordinate. In this case, we show that allowing the boss to plea guilty and cheat the subordinate may enhance *ex ante* efficiency when the latter's information is sufficiently valuable. Essentially, enabling the boss to self-report reduces the set of contingencies in which the subordinate blows the whistle, which in turn reduces the latter's information rent, thereby inducing less crime in equilibrium: an instance in which the divide-and-conquer principle works in both directions. Yet, the boss can be induced to talk only when also the subordinate is willing to do so. Hence, when it is easier to induce low-rank criminals to blow the whistle, then it is also more likely to induce the boss to self-report: a sort of 'domino effect' that squares with the anecdotal evidence reported in Hammond (2004). We also study how the trade off between the bright and the dark side of leniency varies when the Legislator's incentives to restrict the access to the programme are shaped by career and political concerns. It is shown that the optimal policy induces less rationing and excessively high amnesties when political and career concerns inefficiently distort incentives away from *ex ante* efficiency.

On the whole, the basic insights offered by the baseline model are robust to both these extensions and they even survive when the boss can optimally choose the amount of information flowing to the subordinate. Finally, we show that the value of leniency weakens when the boss can buy the subordinate's silence by means of loyalty prizes and strengthens when the subordinate enjoys being part of the organisation over and above the monetary reward he obtains from the boss. In both these cases, the Legislator finds it optimal to offer high-powered incentives to whistleblowers, i.e. full amnesty in the latter case and rewards in the former.

It should be noted that in addition to criminal organisations, the model's insights apply to a number of other interesting contexts where lawbreakers are organisations that feature hierarchal command chains and build their power on intimidation and retribution not only across their borders but also among their members – e.g. political and religious terrorism, or cartels involving firms that feature a hierarchical structure which allows CEOs, who plan the cartel, to delegate its execution to middle level managers.[30] More generally, our analysis suggests that the position of the Legislator would be greatly improved by mitigating the asymmetry of information *vis-à-vis* potential whistleblowers belonging to these organisations. For example, if the information of a criminal is somehow linked to his position in the organisation, the more prosecutors know about the relative position of an agent in the criminal organisation, the better they can assess the quality of his information. This suggests that understanding the structure of these organisations, and how information is

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[30] In fact, our analysis suggests that individual leniency may strongly encourage mid level members of organisations colluding or breaching the law on a larger scale to blow the whistle. In these cases, the bright side of leniency goes beyond unsettling the informant's organisation itself (e.g. a firm breaking the law or a terrorist cell) reaching also the other organisations involved in the cartel. See, e.g. the Lysine case.

distributed across their echelons is important to design better leniency programmes.

Appendix A. Proofs.

Proof of Proposition 1. Recall that θ^* is determined by the subordinate's indifference condition:

$$(1 - \phi)f + (1 - \lambda\theta^*)r = f. \tag{A.1}$$

Hence, an optimal policy that induces the subordinate to blow the whistle is feasible if, and only if,

$$\frac{r - f}{\lambda r} < 1 \quad \Leftrightarrow \quad r < r^* \equiv \frac{f}{1 - \lambda}.$$

In this region of parameters, the optimal policy solves the following maximisation problem:

$$\max_{\phi \in [0,1]} \int_{\theta^*}^1 [\lambda\theta s - \phi f + (1 - \lambda\theta)r]\mathrm{d}G(\theta), \tag{A.2}$$

subject to (A.1).

Using the above definition of θ^*, a simple change of variables allows to rewrite this problem as:

$$\max_{\theta^* \in [0,1]} \int_{\theta^*}^1 [\lambda\theta s + \lambda(\theta^* - \theta)r]\mathrm{d}G(\theta), \tag{A.3}$$

subject to $\theta^* \geq r - f/\lambda r$.

Differentiating with respect to θ^*, in an interior optimum we have:

$$\lambda r[1 - G(\theta^*)] - \lambda\theta^* s g(\theta^*) = 0.$$

Rearranging terms, this yields:

$$s\theta^* - \frac{1 - G(\theta^*)}{g(\theta^*)} r = 0,$$

which has a unique solution in $(0, 1)$ since $[1 - G(\cdot)]/g(\cdot)$ is strictly decreasing by (A.1). Concavity of (A.3) can be immediately checked. Clearly, a sufficient condition to rule out corners is $r - f < \varepsilon$ with $\varepsilon > 0$ and small enough.

Finally, integrating the subordinate's break-even wage evaluated at the optimal policy:

$$w(\theta^*) = f - \int_{\theta^*}^1 [\phi^* f - (1 - \lambda\theta)r]\mathrm{d}G(\theta)$$

$$= f[1 - \phi^* G(\theta^*)] + \int_{\theta^*}^1 (1 - \lambda\theta)rG(\theta)\mathrm{d}\theta,$$

which is clearly strictly positive because $\phi^* \leq 1$ by Assumption A4.

Proof of Proposition 2. Assume that the Legislator's maximisation problem has an interior solution. Using the implicit function theorem together with the fact that $[1 - G(\cdot)]/g(\cdot)$ is strictly decreasing, we have:

$$\frac{\partial\theta^*}{\partial s} = -\frac{\theta^*}{s - r\frac{\partial}{\partial\theta}\frac{1 - G(\cdot)}{g(\cdot)}\Big|_{\theta = \theta^*}} < 0,$$

$$\frac{\partial \theta^*}{\partial r} = \frac{1}{s - r \frac{\partial}{\partial \theta} \frac{1 - G(\cdot)}{g(\cdot)}\bigg|_{\theta = \theta^*}} \frac{1 - G(\theta^*)}{g(\theta^*)} > 0.$$

Hence,

$$\frac{\partial \phi^*}{\partial s} = -\frac{\lambda r}{f} \frac{\partial \theta^*}{\partial s} > 0, \qquad \frac{\partial \phi^*}{\partial f} = -\frac{(1 - \lambda \theta^*) r}{f} < 0, \qquad \frac{\partial \phi^*}{\partial \lambda} = -\frac{\theta^* r}{f} < 0,$$

$$\frac{\partial \phi^*}{\partial r} = \frac{1 - \lambda \theta^*}{f} - \frac{\lambda r}{f} \frac{\partial \theta^*}{\partial r},$$

whose sign is ambiguous since θ^* is increasing in r.

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Additional Supporting Information may be found in the online version of this article:

Appendix B. A Closed-from Example.
Appendix C. Extensions.
Appendix D. Direct Mechanisms: 'Revenue Eqivualence'.
Appendix E. Proofs.

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