DISCUSSION PAPER SERIES

No. 9543

ACCOMPLICE-WITNESS AND ORGANIZED CRIME: THEORY AND EVIDENCE FROM ITALY

Antonio Acconcia, Giovanni Immordino, Salvatore Piccolo and Patrick Rey

INDUSTRIAL ORGANIZATION

Centre for Economic Policy Research

www.cepr.org

ACCOMPLICE-WITNESS AND ORGANIZED CRIME: THEORY AND EVIDENCE FROM ITALY

Antonio Acconcia, Università Federico II di Napoli and CSEF
Giovanni Immordino, Università di Salerno and CSEF
Salvatore Piccolo, Università Cattolica di Milano
Patrick Rey, Toulouse School of Economics (GREMAQ and IDEI) and CEPR

This Discussion Paper is issued under the auspices of the Centre's research programme in **INDUSTRIAL ORGANIZATION**. Any opinions expressed here are those of the author(s) and not those of the Centre for Economic Policy Research. Research disseminated by CEPR may include views on policy, but the Centre itself takes no institutional policy positions.

The Centre for Economic Policy Research was established in 1983 as an educational charity, to promote independent analysis and public discussion of open economies and the relations among them. It is pluralist and non-partisan, bringing economic research to bear on the analysis of medium- and long-run policy questions.

These Discussion Papers often represent preliminary or incomplete work, circulated to encourage discussion and comment. Citation and use of such a paper should take account of its provisional character.

ABSTRACT

Accomplice-Witness and Organized Crime: Theory and Evidence from Italy*

We develop an agency model of organized crime accounting for the main trade-offs involved by the introduction of an accomplice-witness program. We characterize the optimal policy and identify its main determinants in a framework where public officials can be dishonest. Our predictions are tested by using data for Italy before and after the introduction of the 1991 accomplice-witness program. As predicted by the model and the earlier antitrust literature, the program appears to have strengthened deterrence and enhanced prosecution. Moreover, consistently with a novel prediction of our theory, the evidence suggests that the program efficacy is affected by the judicial system efficiency.

Antonio Acconcia
Department of Economics
University of Naples Federico II
Via Cinthia (Monte S. Angelo)
45 I-80126 Napoli,
ITALY

Giovanni Immordino
Dipartimento di Scienze
Economiche Università di Salerno
Via Ponte don Melillo
80084 Fisciano (SA)
ITALY

Email: antonio.acconcia@unina.it

Email: giimmo@tin.it

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=173395

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=143306

Salvatore Piccolo
Department of Economics
Università Cattolica di Milano,
Via Necchi 5,
20123 Milano
ITALY

Email: salvapiccolo@gmail.com

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=160644

Patrick Rey
School of Economics
Place Anatole France
31042 Toulouse Cédex
FRANCE

Email: patrick.rey@tse-fr.eu

For further Discussion Papers by this author see:
www.cepr.org/pubs/new-dps/dplist.asp?authorid=103815

1 Introduction

Since Becker (1968) organized crime has attracted considerable attention by economists, and for good reasons. The diffusion of criminal organizations, whose internal structure is built on cohesive and militarized echelons, has forced governments all over the world to reform their legal and judicial systems to enhance the performance of investigation agencies and to strengthen deterrence. These reforms have promoted the approval of special laws that have radically changed conviction and imprisonment procedures.

A notable example is the introduction in many countries of accomplice-witness regulations (also known as leniency programs), whose aim is to encourage former mobsters to blow the whistle and cooperate with prosecutors in exchange of legal benefits. The prevailing rationale for these polices rests largely on the argument that the most culpable and dangerous criminals rarely do the 'dirty job'. Even if these individuals are primarily responsible for the crimes committed by their 'soldiers', they hardly get sentenced because their role is typically confined to behind-the-scenes control and guidance. This explains why allowing low-tier criminals to flip and turn informants seems a potentially key channel to fight organized crime.

Yet, so far, very few models have studied the basic trade-offs shaping the optimal design of cooperation amnesties in criminal proceedings where whistleblowers and defendants belonged to the same organization and have been in a principal-agent type of relationship. Moreover, despite the substantial economic costs of these programs and the ethic concerns triggered by their approval, the evidence on their performance is still quite limited.[1]

Why should lawbreakers be rewarded with lighter sanctions when they decide to blow the whistle and cooperate with the justice? What are the key determinants of the amnesties they receive as a prize for cooperation? What is the relationship between the costs and benefits of accomplice-witnesses programs, the hierarchical structure of criminal organizations, the efficiency of the judicial system and the amount of corruption in the economy? How did these programs perform in practice?

To address these issues we first develop a model where (endogenous) legal benefits are granted to flipping criminals belonging to a hierarchical criminal organization in order to break down the 'code of silence' that typically makes it hard to fight organized crime. Second, building upon the model main insights, we draw a number of empirical predictions on the effects of these programs that are tested by using the evidence available for Italy before and after the introduction of the 1991 accomplice-witnesses program.

Hence, the paper builds on two main blocks. In the first part, we analyze a simple model showing that granting an amnesty to former criminals willing to cooperate with the justice has a clear economic logic. We argue that two countervailing effects contribute to determine these amnesties. On the one hand, rewarding flipping criminals with lower punishments exacerbates conflicts within criminal organizations. More precisely, a more generous amnesty may induce criminals under investigation to cooperate more often, thereby increasing the prosecution risk faced by their boss: this is the *bright side* of leniency programs. On

---

[1]See the related literature in Section 5.

the other hand, it encourages the entry of new fellows into the illegal business by lowering their expected sanction and thus the compensation that the boss has to secure them at the hiring stage. This effect brings out a potential *dark side* of leniency programs, whose strength depends upon several features of the criminal organization such as, for instance, the degree of cohesion among its members, the boss retribution power, the amount of corruption in the economy and the corroborating value of the whistleblowers' testimony.[2] Building on the interplay between these two effects, we then show that an optimal policy — i.e., selected so as to minimize crimes — reduces the crime rate and increases the conviction probability of the organization top echelons. Moreover, the incentives to blow the whistle are determined, among other things, by the expected conviction probability that a low-tier criminal faces when he does not cooperate and obeys to the code of silence imposed by his partners. It is also shown that more generous amnesties (or even monetary rewards) are necessary to fight organized crime when the judicial system is not very effective, criminal organizations feature strong internal cohesion between their members, the information provided by accomplice-witnesses has a valuable investigative content and there exist strong external complicities between public officials and criminal organizations (corruption).

In the second part of the paper we use the model predictions to guide an empirical investigation on the accomplice-witness program introduced by the Italian parliament in the 1991 to fight the mafias. The unifying objective of our empirical investigation is twofold. First, we wish to provide evidence supporting the idea that these programs are likely to produce beneficial impact on deterrence and prosecution, which can hopefully mitigate the political and ethical prejudice against them. Second, we wish to use the model predictions together with the available evidence in order to better understand the forces that shape the performance of such programs in practice.

Clearly, taking our theory to the data is a challenging endeavor mainly because of the lack of systematic data (which is a common issue in this type of empirical work). Nevertheless, we believe that the overall evidence collected points in the direction of the model main predictions. In particular, even if we cannot perform a robust *before* and *after* analysis in terms of prosecution rates (mainly because, for the years before the 1991, data are only available at aggregate level) we do find strong evidence of a differential trend after the 1991 by comparing prosecution rates at province level for mafias and other criminal organizations. Moreover, we also find evidence that the efficacy of the program seems to be positively correlated with efficiency of the judicial system. Further predictions of the model accord with less systematic evidence. For example, the model shows that high-powered incentives — i.e., very large amnesties and even monetary rewards — are needed when criminal organizations exhibit strong internal cohesion, which might partly explain why very few accomplices belong to the Calabrian 'Ndrangheta, whose members are mainly linked by blood relationships. Finally, data suggest a novel positive correlation between the number of whistleblowers entering the Italian program and the number of bosses convicted and jailed: a prediction that is peculiar to our vertical hierarchy approach to criminal organizations.

Finally, although our theoretical construct is tied to the specific mafia example, for which we were able

---

[2]In contrast to our model where the dark side of leniency program is a feature emerging at the optimum, Buccirossi and Spagnolo (2006) discuss the effects of badly designed leniency programs.

to report empirical evidence, the scope of our conclusions has a wider appeal. Our model, for instance, can be easily applied to study the impact of leniency policies in the fight against religious and political terrorism. Baccara and Bar-Isaac (2008) note that these organizations typically build their power on intimidation and violence not only across their borders but also among their members: two key features of our model as well. Notable examples where the use of insider information has greatly supported the prosecution activity include the fight against the Italian Red Brigades, the German Baader-Meinhof, the US street gangs and the more recent war against religious terrorism — e.g., organizations like Al Qaeda.

The rest of the paper is structured as follows. Section 2 provides an overview of organized crime and accomplice-witness regulations in Italy, in addition to some preliminary and motivating evidence about the deterrence effect produced by the Italian leniency program on mafia crimes. Section 3 sets up the theoretical model and develops the main characterization results along with the comparative statics. In Section 4 we take to the data some of the predictions of the theoretical model. Section 5 relates our work to the earlier literature. Section 6 concludes. Proofs, data sources and definitions are in the Appendices.

2 The Italian experience

In this section we discuss some preliminary evidence about the Italian accomplice-witness regulation. The objective is to better understand the main roots of the Italian leniency program and use this evidence to guide the theoretical construct developed in Section 3.

2.1 Criminal organizations and leniency in Italy

In 1982, the Italian Legislator, recognizing the pervasive role of 'mafia-type criminal associations', introduced the article 416-bis of the Penal Code, which defines a mafia association as characterized by "the exploitation of the force of intimidation of the associative tie and of the condition of subjugation and silence (*omertà*) which derives from it" and makes it a crime offense to belong to a mafia family.[3]

From 1982 to 2001, the new offence led to the convictions of 5,443 Italian citizens. Data at regional level show that 5,069 individuals, that is, more than 93% of the convicted mobsters, were sentenced in 4 out of the 20 Italian regions: Sicily and Campania exhibit the highest number of convictions, followed by Puglia and Calabria (Table 1). These regions (hereafter core-regions) have historically been troubled by different mafia groups: the Camorra in Campania, the 'Ndrangheta in Calabria, the Sacra Corona Unita (SCU) in Puglia, and the Mafia in Sicily. Each group consists of a number of mafia associations, the most 'famous' being Cosa Nostra in Sicily.

Insert Table 1 here

---

[3]Many offences correspond to the illicit activity of criminal associations (for instance, drug traffic, loan sharking, murder, and extortion). However, the mafia association offence refers specifically to the use of fear through the force of intimidation by the entire organization. Thus, a common crime offence such as extortion is sentenced in a different way when it is committed through mafia intimidation. Moreover, even a licit goal may be prosecuted if it is achieved through the force of subjugation.

The strength of the Italian mafia associations, as well as their increasing influence on the legal economic activity, rest on a diffuse external complicity, namely, special relationships between criminal heads and public officials such as national or local politicians, judges, local administrators and members of the police force (Dickey, 2004). In order to break down omertà and weaken these external complicities, the Italian Legislator decided to set harsher punishments for mafia affiliates and, at the same time, to grant full or partial amnesty to whistleblowers who provide information leading to further mafia prosecutions or revealing external complicities: the Italian accomplice-witness program (D.L. 13/05/1991 n. 152). In the same year the Legislator also introduced a protection program, aimed at protecting those who endanger themselves because of the information provided to the judicial authority (D.L. 15/01/1991 n. 8).

Insert Table 2 here

Table 2 reports the 2008 distribution of former mafia accomplices who took part in the protection program (they are grouped on the basis of the criminal association they provided information about). On the whole, 729 out of 833 accomplices — i.e., 87% of the total — provided relevant information on the four mostly known mafia groups; the Sicilian mafia and the Camorra are each concerned by roughly one third of dissociates. Table 2 also shows that 93% of the proceeds confiscated concern the Camorra, Sicilian mafia, 'Ndrangheta, and SCU. As for the number of accomplices, the Camorra and the Sicilian mafia are those mostly affected by the confiscation laws.

2.2 Buscetta meets Falcone: the emergence of accomplice-witnesses

Tommaso Buscetta is widely recognized as the first important criminal breaking the code of silence in Italy. During the 1980s he helped the judges Giovanni Falcone and Paolo Borsellino to achieve significant successes in the fight against organized crime. He was the key witness in the Maxi Trial that sent almost 350 Mafia members to prison. In particular, Buscetta exposed the existence and the workings of the 'Sicilian Mafia Commission'.[4] His cooperation enabled Falcone to argue that Cosa Nostra was a unified hierarchical structure ruled by a Commission, and that its leaders could be held responsible for the criminal activities committed to benefit the organization. This premise became known as the 'Buscetta theorem' and was at the root of the Maxi Trial sentence in January 1992. His testimony in the 'New York Pizza Connection Trial' in the mid-1980s also enabled the conviction of hundreds of mobsters in Italy and the United States. As a reward for his help, Buscetta was allowed to live in the USA under a new identity in the Witness Protection Program.

Until the 1990's, few '*pentiti*', albeit significant ones, followed Buscetta's example. This changed significantly when, thanks to the intense activity of Falcone's investigative group (the so-called *pool Antimafia*), the Italian Legislator introduced in 1991 the accomplice-witness protection program. Since then, over a thousand mafiosi have agreed to collaborate with Italian justice.

---

[4]The Commission was a body of leading Mafia members deciding on important questions concerning the actions of, and settling disputes within the Sicilian Mafia.

Several other features are worth noting. First, accomplices rarely decided to blow the whistle before being under investigation. Second, strikingly enough, many among the most influential mafia heads never cooperated with the justice, even if being charged with several life sentences. For instance, Raffaele Cutolo, Luciano Liggio, Bernardo Provenzano, Totò Riina and Francesco Schiavone, repeatedly refused any collaboration with prosecutors in order to protect — or so they claimed — their status of 'man of honor'. Finally, the program poorly performed in Calabria, where at the end of 2008, only 95 former 'Ndrangheta affiliates were in the protection program. The 'Ndrangheta thus seems to feature a greater cohesion than Cosa Nostra and the Camorra, which can be related to differences in recruitment methods. The 'Ndrangheta recruits members on the criterion of blood relationships, which results in a tight cohesion within the family clan that presents a major obstacle to investigations (Paoli, 2003).

2.3 Accomplice-witness and mafia trials

The first important Italian trial against the Sicilian Mafia opened in 1967 and concerned its growing involvement in the heroin trade. The trial ended one year later with the acquittal of all defendants. In the same period, judge Cesare Terranova sent to trial 114 defendants, with the view that the crimes and those accused of carrying them out were all linked and should be treated as an organized body. The defendants were accused of crimes relating to the first mafia war, with charges including multiple murder, kidnapping, tobacco smuggling, theft, public massacre and organized crime — see, e.g., Gambetta (1992). The trial lasted for a year and resulted in only ten convictions, several of which being only for organized crime.[5]

The third trial began in February 1969. There were sixty-four defendants, all from the town of Corleone (Sicilia). The charges related to a mafia war in Corleone that started in 1958, and resulted in over fifty murders. There was significant evidence tampering during the trial, which experienced the first public intimidation act. All sixty-four defendants were acquitted. Whilst there was undoubtedly witness intimidation and evidence tampering, much of the evidence was fairly thin. There were no *pentiti* at the time and few non-Mafiosi willing to risk death by testifying for the prosecution.

During the early 1980s, a period known as the second mafia war started, resulting in hundreds of murders, including several high-profile public authorities. The growing public revulsion at such killings provided the necessary premise to the 'Palermo Maxi Trial', whose preliminary phase was headed by judges Giovanni Falcone and Paolo Borsellino. Never before so many Mafiosi were on trial at the same time in Italy. A total of 474 defendants were facing charges, which included 120 murders, drug trafficking, extortion, and, under the new law, being a member of the Mafia. Most of the crucial evidence came from the first two important whistleblowers: Tommaso Buscetta and Salvatore Contorno. The trial ended on December 1987, almost two years after its beginning. Of the 474 defendants 360 were convicted; 2,665 years of prison sentences were

---

[5]Before 1967 people did not even recognize the existence of 'Cosa Nostra', while in reality this organization developed and settled since the early 1900. While the economic origins of the mafia(s) remain relatively unexplored, Bandiera (2003) offers an interesting theory and some empirical evidence about the development of the mafia in the west of Sicily. More recently, Buonanno et al. (2012) extend the data and the scope of the empirical analysis to study the difference in the incidence of the mafia between eastern and western part of the island.

shared out between the guilty, not including the life sentences handed to the nineteen leading Mafia bosses and killers.

The major Italian trial against organized crime not involving Sicilian mobsters was the 'Spartacus Maxi Trial', which was specifically directed against the activities of the powerful Casalesi association of the Camorra and its boss Francesco Schiavone. The trial lasted for ten years (July 1998 - June 2008) and charged 36 members of the clan with a series of murders and other crimes. All were found guilty and 16 sentenced to life imprisonment, including the Casalesi head Francesco Schiavone and his chief *lieutenant*, Francesco Bidognetti. More than 500 witnesses and 25 informants testified in the trial, which ended with a total of 700 years of imprisonment and nearly 6 billions euros confiscated (Anselmo and Braucci, 2008). Very recently a large number of people has been arrested because of being part of the Casalesi association mainly thanks to information provided by whistleblowers.

3   The model

Building on the insights offered by the historical evidence discussed above, in this section we set-up and derive the equilibrium outcome of a game where the Legislator strategically designs a leniency program to disseminate conflict between the members of a hierarchical criminal organization.

Players and environment: The game involves a benevolent Legislator, a criminal organization and a continuum of public officials. The Legislator, having forbidden welfare reducing criminal acts, designs an accomplice-witness program. For simplicity, the criminal organization is formed by two mobsters: a boss (the principal) and a fellow (the agent) which are in a principal-agent type of relationship (in the Appendix we consider a model with a multi-agents organization). The boss is the mind of the organization, who plans the crime; the agent is the arm, who materially commits the illegal act.[6] Public officials, either prosecutors or members of the police force, influence the probability of convicting a defendant.

The crime yields a revenue R, which is stochastic and distributed over the compact support $[0, \overline{R}]$ according to the cumulative distribution function $F(R)$. The principal hires the agent after having observed the realization of R; he has full bargaining power and makes a take-it or leave-it offer, which entails a wage w paid by the principal to the agent after the crime is committed, but before the investigation takes place. For simplicity, we normalize the agent's outside option to zero.

Prosecution: Committing the crime triggers an investigation with probability α. We assume that two types of public officials may be in charge of the judicial and investigative process. Building on the historical evidence discussed in Section 2, we assume that there are *honest* officials, which do not have links with the criminal group, and thus always seek to convict the mobsters under investigation, and *dishonest* officials, which are instead ready to acquit the defendants whenever possible. There is an overall measure 1 of officials

---

[6] At the bottom of the chain of command, the *picciotti d'onore*, or soldiers, are expected to perform tasks with blind obedience until they are promoted to the next level, where they will be granted command over their own group of soldiers. See, e.g., Dickey (2004).

in the economy, a fraction β of which is honest. The official's type is observed only by the principal but not by the agent, who is unaware of the hidden links between his head and law-enforcers.[7]

The parameter β reflects the 'influence' of the organization on prosecutors and, therefore, it affects the efficiency of the judicial system. It might be determined not only by aggregate factors — such as economic, institutional and technological conditions — but it is also often linked to local factors such as cultural diversity and specific features of the criminal organizations operating in a given area.

Hence, dishonest types can be either interpreted as linked to the criminal organization for cultural and personal reasons or as being bribed or intimidated. Criminal organizations indeed frequently tried to manipulate court decisions by bribing, threatening, and, occasionally, even murdering judges and prosecutors. Tommaso Buscetta was the first to expose in detail the secret exchanges that linked politicians to the Sicilian mafia. On November 1992, he testified in front of the Antimafia Commission about the links between Cosa Nostra and Salvo Lima, indicating Lima as the politician to whom Cosa Nostra turned most often to resolve problems for the organization whose solution laid in Rome. Bruno Contrada, a former head of the Italian Intelligence Agency, was sentenced to ten years for collusion with Cosa Nostra. He was accused of informing the Sicilian mafia on upcoming police operations, preventing in particular an early capture of the fugitive Totò Riina ("Audizione del collaboratore di giustizia Gaspare Mutolo", Antimafia Commission, February 9, 1993). For simplicity, here we do not explicitly model the corruption and the intimidation process that generates the official's type.[8]

Legal regimes:

- **No leniency**: if the public official is honest, the agent is convicted with probability p and bears a sanction S_a, whereas the principal is convicted with probability $\underline{\theta} \leqslant p$ and bears the sanction S_p. Hence, convicting the crime instigator is harder than convicting the soldier (who has materially committed the crime). Otherwise, both mobsters are acquitted.[9]

- **Leniency**: when the investigation starts, the agent can opt to blow the whistle and cooperate with the justice, which requires a testimony at trial against his boss. The reward for this cooperation is a reduction by ϕ of the sanction S_a. If the agent cooperates, the boss bears the sanction S_p with probability $\overline{\theta} \geqslant \underline{\theta}$, regardless of the official's type.[10] In practice, to obtain a conviction the witness' testimony needs corroboration from unrelated sources; we can therefore interpret $\overline{\theta}$ as a measure of

---

[7]The available historical evidence offers ample support for this hypothesis. For instance, security concerns have led to the creation in the 'Ndrangheta of a secret society within the secret society: La Santa. Membership in the Santa is only known to its members. Bosses belonging to the Santa have precisely the objective of establishing close connections with state representatives, and simple soldiers are unaware of these connections. Assuming that the official's type is observed by both the principal and the agent would not add new key insights to our analysis, however. In that case, the agent's reporting strategy would depend on the official's type (only when the official is honest would the agent possibly report evidence against the boss) but the basic insight would be similar: a more lenient policy makes agents facing honest officials more willing to cooperate.

[8]An earlier version of the paper formally introduced a 'bribing' stage to determine the fraction of dishonest officials. The main comparative statics were qualitatively the same.

[9]Although p may capture economic and institutional conditions, it cannot pin down factors such as cultural diversity and specific features of the criminal organizations, which are suitably captured by β.

[10]We assume that a dishonest official can no longer manipulate the trial when the agent cooperates. This is consistent with

the reliability of the informant. This parameter may for example reflect the status of the informant in the organization or its proximity to the leader: mobsters at a higher level in the hierarchy constitute a better source of information than simple 'soldiers' who execute orders blindly. Finally, in the light of the evidence reported in Section 2, we rule out the possibility that the boss talks as well as the possibility that the agent decides to cooperate before an investigation is opened.

Trial-reluctance, cohesion and retaliation: In order to model conflict within the organization in a simple way, we assume that the agent is reluctant to face a trial, which translates into a private cost δ.[11] This parameter is drawn from a compact support $[\underline{\delta}, \overline{\delta}]$, according to the atomless and twice continuously differentiable cumulative distribution function $G(\delta)$. The agent learns δ when an investigation is opened.[12] For example, δ can reflect the psychological costs resulting from the fear and apprehension of imprisonment, which materialize when the agent is about to face the trial;[13] or, it might reflect the emotional costs the mobster incurs when he realizes either the danger to which his children are exposed, or the consequences of the 'Mafia stigmata'. As observed by judge Falcone in his last interview (1991), the willingness to cooperate may also reflect an unanticipated low degree of trust and cohesion inside the organization. For example, internal fights between formerly allied clans and partners (see, e.g., also Gambetta, 1992, pg. 162) might encourage the losers to have their revenge by cooperating with the justice.[14]

We also assume that criminal organizations seek to punish whistleblowers, a feature that we model as a retaliation loss L suffered by the informant. The ability of a witness to give testimony in a judicial setting or to cooperate with law enforcement investigations without fear of intimidation or reprisals is essential. Increasingly, countries are enacting legislation or adopting policies to protect witnesses whose cooperation with law enforcement authorities or testimony in a court of law would endanger their lives or those of their relatives. Accordingly, we shall interpret a lower value of the loss L as the result of better witness protection programs or as a weaker retribution power of the organization.[15]

Timing: We follow the literature in assuming that the Legislator moves first.[16] The sequence of events is

the evidence discussed in Section 2.3, which underlines the difference in the results of mafia trails with and without *pentiti* (arguably with a constant fraction of disloyal officials). Moreover, the main trade-off is still at work if one assumes that the measure of corrupted officials reduces the chance that the boss is incriminated, but this reduction is not too large.

[11] The idea that the decision to cooperate or not depends on the interim stochastic realization of a parameter is also made in Harrington (2008) who allows the probability of discovery and successful prosecution of a cartel to change over time.

[12] The analysis applies unchanged if the uncertainty realizes before any investigation but the principal cannot use revelation mechanisms that condition the wage on the agent's type.

[13] In mafia trials the imprisonment of defendants is often mandatory even before the definitive verdict for precautionary reasons. And the trial can be very long depending on the importance of the charges and the number of defendants (the Spartacus Maxi Trial, for example, lasted ten years).

[14] The idea that leniency programs can act as anticipated "threats" within criminal organization has been also studied in the collusion literature — see, e.g., Buccirossi and Spagnolo (2006) and Spagnolo (2000) for a static analysis, and Ellis and Wilson (2001) for its dynamic extension. As we will see, in our model leniency does not play the role of a threat given that the agent has no bargaining power. Introducing such additional effect into the analysis would not change the main qualitative insights, but it would only strengthen the dark side of leniency.

[15] For simplicity we assume that this loss is exogenous. At the end of this section we explain why our conclusions would not change were this choice endogenous.

[16] See e.g. Motta and Polo (2003), Spagnolo (2003) and Rey (2003).

as follows:

t=0 The Legislator decides whether to launch a leniency program and accordingly commits to an amnesty rate ϕ.

t=1 Uncertainty about R resolves and the principal decides whether to commit the crime; if it chooses not to commit the crime, the game ends, otherwise the principal pays the wage w to the agent once the crime is committed and the game then proceeds to the investigation stage.

t=2 An investigation opens with probability α. The public official in charge of the case is honest with probability β and dishonest with probability $1 - \beta$. The type of the public official is not observed by the agent.

t=3 The agent learns his personal costs of facing the trial (δ) and, if a leniency program is in place, decides whether to blow the whistle. Depending on the legal regime, the trial uncertainty resolves, and sanctions (including the retaliation loss) are imposed.

In the Appendices we provide a detailed illustration of the game tree.

Actions and equilibrium concept: An action profile for the principal involves a wage offer w. An action profile for the agent involves a participation rule, based on the wage offered, and a confession decision — i.e., whether to cooperate or not, which will depend on his type δ. The Legislator simply announces ϕ. We shall look for the subgame perfect Nash equilibrium (SPNE) of this game.

Technical assumptions: For ease of exposition we will maintain the following conditions:

A1 Monotone hazard rate. Let $h(\delta) \equiv (1 - G(\delta)) / g(\delta)$ denote the inverse hazard rate, then:

$$\delta > \delta' \Rightarrow h(\delta) < h(\delta'). \tag{A1}$$

As shown in Appendix 1, **A1** ensures that the Legislator's program is single-peaked. It is adopted in many economic applications and satisfied by standard distributions.[17]

A2 Cooperation.

$$h(\underline{\delta}) > (\overline{\theta} - \beta\underline{\theta}) S_p. \tag{A2}$$

This condition rules out the uninteresting case where no agent ever talks in equilibrium. It can be easily satisfied by standard distribution functions.

Finally, following the literature, all sanctions will be interpreted as the monetary equivalent of the imprisonment terms, fines, damages, and so forth, to which the criminals expose themselves. This assumption is made only for exposition purposes. Our insights readily extend to non-monetary sanctions.

---

[17]For instance, the uniform distribution satisfies **A1.**

3.1 Equilibrium characterization

We now characterize the equilibrium of the game. We shall first consider the no leniency case before introducing leniency.

3.1.1 No leniency

We consider first the subgame with no leniency. If an investigation opens, the agent must face the trial. The principal's expected gain is then:

$$v = R - w - \alpha\beta\underline{\theta}S_p,$$

where w is the expected wage paid by the principal; this expected wage will be set so as to compensate the agent for his participation into the criminal business:

$$w = \alpha p\beta S_a + \alpha\mathrm{E}[\delta], \tag{1}$$

where $\mathrm{E}[\delta]$ is the expected cost that the agent bears from the trial, while $p\beta S_a$ is the agent's expected sanction.

The principal will decide to go on with the crime if and only if the return R is larger than the expected costs, that is:

$$R \geqslant R_n \equiv \alpha\beta\left(pS_a + \underline{\theta}S_p\right) + \alpha\mathrm{E}\left[\delta\right].$$

The crime is less profitable, the higher is the probability that an investigation is opened (α large), the more severe and efficient the prosecution system (p, S_a and S_p large), the larger the fraction of honest officials (β large) and the higher the agent's expected cost from the trial or the lower the cohesion between the members of the organization ($\mathrm{E}[\delta]$ large). In the absence of leniency, the economy crime rate is thus given by:

$$r_n = \mathrm{Pr}(R \geqslant R_n) = 1 - F(R_n).$$

We shall see below how the possibility of launching a leniency program affects this rate.

3.1.2 Leniency

In this section we derive the optimal leniency policy using a simple backward-induction logic. Once an investigation is launched, not cooperating exposes the agent to the cost of the trial, δ, and to an expected sanction, $p\beta S_a$; in contrast, cooperating reduces the sanction to $(1 - \phi)S_a$, but exposes the agent to the retaliation loss, L. Hence, the agent's payoff are:

$$u = \begin{cases} -(1-\phi)S_a - L & \text{if he cooperates,} \\ -p\beta S_a - \delta & \text{if he does not.} \end{cases} \tag{2}$$

10

He will therefore cooperate as long as his type δ is larger than a threshold, $\widehat{\delta}(\phi)$, equal to:

$$\widehat{\delta}(\phi) \equiv (1 - \phi - \beta p) S_a + L. \tag{3}$$

The expression of the threshold shows that the agent is keener to talk the more generous the amnesty rate, ϕ, the higher the proportion of honest officials in the economy, β, and the more effective the prosecution stage, as measured by p. Cooperation is also more attractive when leniency is complemented with an effective witness protection program that reduces the loss from retaliation, L.

The leniency rate ϕ thus determines the cooperation threshold $\widehat{\delta}$. Without loss of generality we can restrict attention to $\widehat{\delta} \in [\underline{\delta}, \overline{\delta}]$; indeed, any program leading to $\widehat{\delta} > \overline{\delta}$ is ineffective (and formally equivalent to $\widehat{\delta} = \overline{\delta}$), whereas any program leading to $\widehat{\delta} < \underline{\delta}$ is too generous: compared with $\widehat{\delta} = \underline{\delta}$, it reduces further the expected sanction from committing a crime (by offering a reduction ϕ exceeding what is needed to convince all types of agent to cooperate), without any offsetting benefit in terms of cooperation (since all types of agent cooperate anyway). Conversely, for any $\widehat{\delta} \in [\underline{\delta}, \overline{\delta}]$, the agent's participation constraint can be written as:

$$u = w - \alpha \left[\int_{\widehat{\delta}}^{\overline{\delta}} ((1 - \phi) S_a + L) \, dG(\delta) + \int_{\underline{\delta}}^{\widehat{\delta}} (p\beta S_a + \delta) \, dG(\delta) \right] \geqslant 0.$$

Clearly, this constraint will be binding, so that the equilibrium wage makes the agent just indifferent between committing the crime and enjoying his reservation utility, that is:

$$\begin{aligned}
w(\widehat{\delta}) &= \alpha \left[\int_{\widehat{\delta}}^{\overline{\delta}} ((1 - \phi) S_a + L) \, dG(\delta) + \int_{\underline{\delta}}^{\widehat{\delta}} (p\beta S_a + \delta) \, dG(\delta) \right] \\
&= \alpha (p\beta S_a + \mathrm{E}[\delta]) - \alpha \int_{\widehat{\delta}}^{\overline{\delta}} (\delta - \widehat{\delta}) \, dG(\delta).
\end{aligned}$$

The last term illustrates the dark side of leniency: by reducing the expected sanction from committing the crime, it allows the boss to offer a lower wage and thus makes the criminal activity more profitable. The bright side of the leniency program comes from the increased likelihood of prosecution: whenever the agent is sufficiently reluctant to face a trial ($\delta \geqslant \widehat{\delta}$), his cooperation with the justice increases the probability of successfully prosecuting the boss from $\beta\underline{\theta}$ to $\overline{\theta}$. As a result, the principal's expected sanction is now equal to:

$$C(\widehat{\delta}) = \alpha \beta \underline{\theta} S_p + \alpha \int_{\widehat{\delta}}^{\overline{\delta}} (\overline{\theta} - \beta\underline{\theta}) S_p \, dG(\delta).$$

The principal's expected utility from the criminal activity is now given by:

$$v = R - w(\widehat{\delta}) - C(\widehat{\delta}).$$

We assume that the Legislator sets the amnesty rate ϕ, or equivalently the cooperation threshold $\widehat{\delta} = \widehat{\delta}(\phi)$, so as to minimize the crime rate — this seems to be the objective function that politicians and

11

prosecutors supporting the introduction of the program had in mind (see, e.g., Falcone, 1991). Formally, the crime rate is

$$r_l = 1 - F(R_l(\widehat{\delta})),$$

where $R_l(\widehat{\delta})$ is the revenue threshold above which the criminal activity is profitable:

$$R_l(\widehat{\delta}) \equiv w(\widehat{\delta}) + C(\widehat{\delta}) = R_n + \alpha \int_{\widehat{\delta}}^{\overline{\delta}} \left[(\overline{\theta} - \beta\underline{\theta})S_p - (\delta - \widehat{\delta}) \right] dG(\delta).$$

The Legislator' program thus amounts to solve:

$$\mathcal{L} \ : \ \max_{\widehat{\delta} \in [\underline{\delta}, \overline{\delta}]} R_l(\widehat{\delta}).$$

Letting $h(\delta) \equiv (1 - G(\delta)) / g(\delta)$ denote the inverse hazard rate, we have:

Proposition 1 *Under **A1** and **A2**, the Legislator's program $\mathcal{L}$ has a unique solution, $\widehat{\delta}^* = \widehat{\delta}(\phi^*)$, that is interior and characterized by the first-order condition:*

$$h(\widehat{\delta}^*) = (\overline{\theta} - \beta\underline{\theta})S_p. \tag{4}$$

The first-order condition (4) reflects the balance between the bright and dark sides of leniency. On the one hand, increasing the amnesty ϕ reduces the agent's expected sanction for the $1 - G(\widehat{\delta})$ agents who apply for leniency; this makes running criminal activities less costly for the principal. On the other hand, a higher amnesty convinces $g(\widehat{\delta})$ additional agents to cooperate with the justice, increasing the probability of convicting the principal, whereby stifling his incentive to engage in criminal activities.

This trade-off shows that it is always optimal to adopt a leniency program: starting from $\widehat{\delta} = \overline{\delta}$, an increase in ϕ, inducing a small reduction in $\widehat{\delta}$, generates a benefit in terms of enhanced likelihood of prosecution, without any offsetting cost in terms of reduced sanctions — since no agent was initially applying for leniency. By construction, this implies that, compared with the benchmark case of no leniency:

- the probability of convicting the principal is increased, by $(\overline{\theta} - \beta\underline{\theta})(1 - G(\widehat{\delta}^*))$;

- the principal's expected costs is also higher, and the crime rate is lower: $r_l^* < r_n$.

The next proposition discusses the main drivers of the optimal policy:

Proposition 2 *The optimal policy is such that:*

- *the fraction of agents who cooperate, as well as the amnesty rate:*

  - *increases with the quality of the evidence provided by the informant, $\overline{\theta}$, or the sanction for the principal, S_p;*

12

– *decreases when the fraction of honest officials, β, or the probability of convicting the boss, $\underline{\theta}$, increase;*

- *in addition, the amnesty rate:*

  – *increases with the retaliation loss L;*

  – *decreases when the probability of convicting the agent, p, increases;*

  – *increases with the agent's sanction S_a if ϕ^* is lower than the probability of acquittal in case of trial, $1 - \beta p$; the converse holds otherwise.*

The amnesty program should be more generous, the more effective is the evidence provided by the informant for convicting the boss of the criminal organization, the less likely the boss would be convicted in the absence of cooperation and the harsher the punishment for the boss. Indeed, all these parameters increase the value of cooperation, measured by the deterrence factor $(\overline{\theta} - \beta\underline{\theta})S_p$. Also, in order to maintain an appropriate level of cooperation, higher amnesty rates are needed to offset an increase in the retaliation loss, L, which is a 'technological' measure of the organization's military power, or a decrease in the probability of convicting the agent, βp, which is instead a measure of the efficiency and honesty of the legal system and its actors. Note, in particular, that an increase in the proportion of honest officials calls for reducing the amnesty rate, since a higher β fosters cooperation but lowers its deterrence factor. Finally, the impact of the agent's sanction S_a on the optimal policy depends on the effect that harsher sanctions produce on the agent's propensity to cooperate. If the optimal amnesty ϕ^* is lower than the probability of acquittal $1 - \beta p$, increasing the sanction S_a discourages cooperation; the Legislator must then counterbalance this by increasing the amnesty rate. Otherwise, the opposite result obtains.

Theory and Evidence: These results provide a number of empirical predictions, which can be explained in light of the historical and anecdotal evidence discussed in Section 2.

Judge Falcone's whole experience, his strict collaboration with Buscetta and the generous legal and economic benefits that were granted to the earlier whistleblowers are all facts that are consistent with the conclusion that the amnesty rate and the optimal number of whistleblowers should increase the lower the probability of convicting the boss in the absence of insider information is — i.e., as reflected by a lower $\underline{\theta}$. This result is also supported by the historical evidence discussed in Section 2.3, where it is argued that convicting a boss has been very hard, if not impossible, before the introduction of the Italian accomplice-witness program. The same facts altogether are also clearly consistent with the prediction that the legal benefits as well as the optimal number of informants should increase with the quality of information released by the agent — which is reflected by a larger $\overline{\theta}$. In addition the positive effect of a stronger retaliation power on the optimal amnesty also seems to be corroborated by the historical evidence — e.g., this is exemplified by Buscetta's experience discussed in Section 2.2. The need of granting higher amnesties in areas where corruption is more widespread — i.e., lower β — can be instead captured by the 'Ndrangheta example. Historically, this organization features a very large number of members relative to the Calabrian population

size. Prosecutors have often argued that in this area corruption is the 'norm' and not an exception since in many Calabrian villages nearly all citizens belong to the organization. Hence, many among politicians and prosecutors have claimed that more aggressive leniency policies would be needed to achieve acceptable results in this region — see, e.g., Forgione (2008).

Concerning the link between the determinants to whistle and the efficiency of the legal system, the prediction of our model is that the higher is the 'perceived' acquittal probability, $1 - \beta p$, the lower is the number of flipping criminals: an insight that seems to be corroborated by the empirical evidence reported and interpreted in Section 4.3.

Moreover, taken together, the main theoretical predictions of the model also imply that after the introduction of the accomplice-witness program, more mafia crimes should be under scrutiny of prosecutors, thanks to the information provided by former accomplices: a prediction that appears to be in line with the empirical evidence presented in Section 4.2.

A Remark on Rewards: As discussed in Section 2, the anti-Mafia programs not only offer leniency to informants, but often also secure them stable wages, health insurance, housing and other financial supports. It is therefore interesting to see when it is optimal to grant rewards (that is, $\phi^* > 1$).

To address this question, suppose that the parameter δ is uniformly distributed over a support $\left[\bar{\delta} - \Delta, \bar{\delta}\right]$. **A2** then requires $\Delta > \left(\bar{\theta} - \beta\underline{\theta}\right) S_p$ and the first-order condition (4) becomes:

$$\phi^* = 1 - \beta p + \frac{(\bar{\theta} - \beta\underline{\theta})S_p + L - \bar{\delta}}{S_a}. \tag{5}$$

A simple inspection of this condition yields:

Proposition 3 *Suppose that δ is uniformly distributed over $\left[\bar{\delta} - \Delta, \bar{\delta}\right]$; it is then optimal to offer a reward — i.e., $\phi^* > 1$ — whenever $\Delta > (\bar{\theta} - \beta\underline{\theta})S_p$ and:*

$$L - \bar{\delta} > \beta p S_a - (\bar{\theta} - \beta\underline{\theta})S_p. \tag{6}$$

It is therefore optimal to reward accomplices when the criminal organization exhibits a strong internal cohesion ($\bar{\delta}$ low); this is, for instance, the case of organizations such as the Calabrian 'Ndrangheta, whose members are mainly linked by blood relationships. The same applies for L large — i.e., organizations that are powerful on the military side and are therefore more violent when punishing whistleblowers.

Since the threshold is decreasing in $\bar{\theta}$, this is also more likely to be the case when the informant's testimony is highly reliable, as exemplified by the case of Tommaso Buscetta, the first important *pentito*, who was allowed to live in the USA under a new identity in the Witness Protection Program after his testimony in the 'New York Pizza Connection Trial' in the mid-1980s.

As noted above, the necessity of rewarding whistleblowers was already discussed in Spagnolo (2003) and Rey (2003). What is new here with respect to both these papers is the link between internal cohesion of mafia organizations and rewards, a prediction that is supported by the evidence discussed in Section 2.

Extensions: We conclude the section by discussing some extensions of the simple model analyzed so far.

First, a natural way to make the analysis more realistic is to consider a criminal organization that is composed by one boss and more soldiers, each owning information that can be used by the judicial authority to convict the boss. This scenario is analyzed in the Appendix, where we consider a model with two agents that jointly commit the crime and non-cooperatively choose whether to cheat the boss. We show that, in addition to the dark and bright side of leniency already highlighted above, there are two new forces that shape the optimal amnesty in this context. On the one hand, dealing with two whistleblowers induces the Legislator to be less lenient vis-à-vis each of them (relative to the single-soldier organization analyzed so far). This is because, ceteris paribus, the probability of cheating is higher in large organizations than in small ones, which relaxes the tension between the bright and the dark side of leniency. In other words, the members of a multi-agent organization are more willing to talk than in the single-soldier case because they fear that if they don't, their peers might do so. Hence, everything else being held constant, the endogenous uncertainty of a multi-agent model strengthens the bright side of leniency and reduces the optimal amnesty. On the other hand, though, if the information that these agents own features a high degree of complementarity — i.e., if the chance of convicting the boss when two members of the organization cheat is much larger than under a single defection — the Legislator needs to become more lenient, by granting a larger amnesty, because it is in its best interest to have both criminals talking rather than just one.

Second, in the paper we assume (for simplicity) that corrupted officials are passive. However, the bright side of leniency weakens when one considers the case in which corrupted officials help the organization to better retaliate on cheaters — i.e., by enhancing the probability of retaliation. In this case, the higher is the corruption rate, the less incentive criminals have to talk.

Third, throughout, we considered an exogenous retaliation loss and we assumed that the agent does not observe the official's type. Both these restrictions can be easily relaxed. The retaliation loss can be endogenized by assuming that intimidating the agent is costly — e.g., perhaps because it requires effort provision by the boss that could be profitably supplied in other tasks — but may entail future 'reputation' benefits: an organization punishing very harshly whistleblowers today might prevent future defections. The trade-off between costs and benefits of an endogenous retaliation loss is then clear and can be easily accommodated in our framework with no loss of insights. The same conclusion applies if one assumes that the agent is aware of the official's type at the time he chooses whether to cooperate. As already noted before, in this scenario the agent cooperates only if the official is honest, but the logic of the model does not change. The main trade-off is still at work if one assumes that the measure of corrupted officials reduces the chance that the boss is incriminated.

Of course, many other interesting extensions remain to be explored. We kept theses issues aside in order to compare in the clearest possible way the main model's predictions with the evidence, but hope to take these further steps in future research.

4 Empirical evidence

In this section we argue that the main predictions of the theoretical model developed above appear to be corroborated by the evidence available for Italy. As the antitrust literature, our model predicts a positive correlation between deterrence, prosecution rates and the introduction of a leniency policy. Hence, to begin with, we show that the Italian accomplice-witnesses policy engendered a sensible reduction of mafia related crimes (see Section 4.1). Then, we 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 (see Section 4.2). Finally, our model also offers two predictions that are peculiar to the fight against organized crime. First, the leniency program creates a shift of prosecutions towards higher echelons of the organization — i.e., when a soldier talks, the boss is more likely to fall (see Section 4.2). Second, the efficacy of the program hinges upon the efficiency of the judicial system, a conclusion consistent with Fyfe and Sheptycki (2006) and Cassidy (2008) (see Section 4.3). In the following we provide evidence also supporting these two specific predictions.

4.1 Deterrence

Since illegal acts do not take place in broad daylight, providing evidence about the effects of new reforms is typically a complex endeavor. For instance, the number of prosecuted crimes might not tell much about the deterrence power of a reform: a policy that deters crimes but that, at the same time, increases the *fraction* of those that are successfully prosecuted, will have an ambiguous impact on the number of prosecuted crimes. As a consequence, a successful policy, which completely deters crime, might be indistinguishable from an ineffective policy with very low detection.[18] In the case of criminal organizations, however, data on murders can partly overcome this measurement obstacle. In fact, almost all murders are uncovered — i.e., the number of reported murders reflects that of committed ones.[19]

Arguably, mafia-related murders also provide a proxy for the volume of the organized crime business — i.e., a variable that pertains more closely to our model. The historical evidence does suggest that the number of mafia-related murders is positively correlated with the expansion of organized crime activity. Many among the most important mafia wars originated either by the emergence of new illicit traffics or by the unexpected increase of state aids to the 'infrastructure' and 'building' sectors.[20] For instance, in Sicily the war that decimated several Sicilian mafia clans in the early 1980s, started when the group lead by Luciano Liggio — i.e., the so called '*corleonesi*' — took over the new business created by the expanding heroin trade and the real estate boom around the city of Palermo. Similarly, in Campania during the second half of the 1970s the group lead by Raffaele Cutolo decimated most of the older Camorra clans. Cutolo and his fellows took over the illicit traffics stemming from the huge increase in unauthorized tobacco smuggling

---

[18]This issue typically arises in the empirical literature on antitrust law enforcement — see, e.g., Brenner (2009), Harrington and Chang (2009) and Miller (2009).

[19]Pinotti (2011) exploits the fact that under-reporting is negligible for homicides to examine the diffusion of the mafia in the southern Italian regions of Apulia and Basilicata over the last thirty years. On this point, see also Marselli and Vannini (1997).

[20]See, among others, Lodato (2006) and Cantone (2008) for evidence on the Mafia and the Camorra, respectively.

and the new business opportunities in the reconstruction sector after the devastating 1980 earthquake.

Insert Figure 2 here

The Italian penal code distinguishes between two categories of murders: (*i*) malicious or intentional murders, whose executor had the deliberate will to commit the crime; and (*ii*) non-intentional or involuntary murders, which are committed without an intentional purpose. Mafia murders — i.e. the number of people killed to achieve mafias' purposes — are part of the intentional murders. Figure 2 shows the number of mafia murders reported by the police forces in Italy, both in absolute level and relative to (intentional) murders unrelated to various mafia organizations. All mafia murders are considered, including those for which the executor is prosecuted and those for which it remains unknown. The vertical bar marks the introduction of the leniency program in 1991. Strikingly, it emerges an inverted U-shaped pattern with a maximum in 1991. Before this year, murders followed an increasing trend culminating with 719 mafia murders, corresponding to roughly 50% of all other malicious murders. The trend is, instead, decreasing after the introduction of the Italian leniency program. In 2007 the number of mafia murders in Italy is down to 119, which is roughly 20% of the remaining murders.

Many explanations may be consistent with the increasing trend. For instance, a compelling possibility relates to the evolution of public spending. In the first half of the 1980s the Italian Government started to concentrate public spending for infrastructures in the 'building sector' which is historically one of the main business sources of mafias, and thus one of the main reasons for which these organizations fight. For instance, in Campania, Puglia, Calabria, and Sicily, the share of public spending for public buildings such as houses, schools and hospitals with respect to total infrastructure spending, increased from 0.15 in 1986 up to 0.36 in 1999. This may explain the sharp increase in mafia related murders before 1991 and suggests that the introduction of the leniency program did have a role in inverting this tendency.

Of course, one may argue that the evolution of murder rates can be explained by a large scale war involving clans of different clusters, each one against the others. In this perspective the drop after the 1991 might have occurred regardless of the program, simply because one gang won and the war ended. This conjecture, however, is at odds with common knowledge. Historians and prosecutors have never documented such large scale war: mafia wars always happened within clusters and not between them.

Alternatively, one might argue that the aggregate evolution of murder rates just reflects a mafia war within a single cluster characterized by a very large number of murders. This explanation is even less likely in light of the evidence collected at province level. In fact, the inverted U-shaped evolution of murder rates is due neither to a composite effect nor to a specific mafia association. This is evident from Figure 3, which reports time series of mafia murders across the four Italian provinces which have the largest records of mafia murders in 1991-92 — i.e., Naples, Reggio Calabria, Catania and Caserta. Patterns very similar to the aggregate one are evident. Arguably, it seems very unlikely that mafia wars started and ended at the same time within all four main mafia-type criminal clusters.

17

<div align="center">**Insert Figure 3 here**</div>

As a final remark we notice that the inverted U-shaped pattern of mafia murders is peculiar to this type of crime, that is it does not characterize non-mafia murders or crimes that are usually unrelated to mafia activities, such as robberies in banks and post offices, as well as kidnappings whose ultimate purpose is not extortion.[21] As a matter of comparison, Figure 4 reports non-mafia murders for regions historically characterized by the least presence of organized crime, that is regions featuring at most one mafia murder per year on average. In this way we minimize the possibility that the police erroneously classified as not related to mafia activity some murders which instead had indeed a mafia root. Figure 5 reports robberies and kidnappings for Italy as a whole. The key aspect to note is that, in contrast to the evidence reported above, in this case there is not a decreasing trend after 1991.[22] Actually robberies and kidnappings exhibit an increasing path during the 1990s.

<div align="center">**Insert Figure 4 here**</div>

<div align="center">**Insert Figure 5 here**</div>

4.2 Prosecution

Two distinct articles of the Italian penal code deal with organized crime — i.e., art. 416 refers to the crime of 'criminal association', while art. 416-bis refers to the crime of 'mafia-type association'. These articles regulate different types of crimes, but share some common features. In general, associations of at least three people may be prosecuted either as criminal associations or as mafia-type associations. Moreover, criminal and mafia-type associations often share the same kind of illicit activities. Nevertheless, the peculiarity of mafia-type associations, as stated by the third clause of art. 416-bis, is the exploitation of the force of intimidation, the code of silence which derives from it and the perverse relationships that such associations build with public officials. For our purpose, the key difference is that the Italian legislator allowed the possibility to enjoy lighter sentences in exchange of valuable information only to mafia affiliates (art. 8 D.L. 13/05/1991 n.152), that is, relative to the feature of mafia-type associations.

The Italian Statistical Office (ISTAT) provides data relative to the prosecutions for criminal and mafia-type association crimes, according to the year in which the judicial authority begins the penal action and the province in which the crime has been committed. In particular, data are available since 1988 for the country as whole and since 1993 at province level.

---

[21]Robberies and kidnappings are usually unrelated to mafia associations. In contrast, kidnappings aimed at extortion may be related to mafias. Indeed, Reggio Calabria, the Calabrian area featuring the highest concentration of 'Ndrangheta clans, is one of the four provinces — Torino, Reggio Calabria, Milano and Roma — with the largest numbers of kidnappings aimed at extortion.

[22]In Figure 4 FVG and TTA stand for Friuli Venezia Giulia and Trentino Alto Adige, respectively, two regions in the north of Italy.

Table 3 shows the top-5 provinces with most prosecutions for both types of crimes. As expected, the provinces with the largest numbers of prosecutions for mafia-type association crimes are all located in Sicily, Calabria and Campania. In contrast, prosecutions for criminal association crimes are more dispersed across the country.[23] Naples and Palermo are the provinces with the highest numbers of prosecutions for mafia; incidentally, Naples is also the province featuring the greatest number of prosecutions for criminal association crimes.

Insert Table 3 here

In Italy, police forces (namely, the *Carabinieri*, the *Polizia* and the *Guardia di Finanza*) generally report crimes to prosecutors, who then decide whether to begin the prosecution procedure. Therefore, a crime reported by the police does not necessarily result in prosecution. However, it may also result in more than one prosecution if the investigation generates fresh information about other crimes. In particular, the information provided by former accomplices participating in the accomplice-witness program is handled by the judicial authority and not by the police. As a result, the ratio between the crimes prosecuted and those reported by police forces appears as a good proxy for assessing the impact of the testimonies delivered by the flipping criminals on the rate of prosecution.

Insert Figure 6 here

Let the variable *PROSECUTION* be the ratio between the number of prosecutions and the number of crimes reported by the police forces. Figure 6 illustrates the evolution of such variable in Italy from 1988 to 2005, for both mafia-type association and criminal association crimes. The former crime is labelled as *Mafias* while the latter as *Others*.[24] The main evidence is that while mafia-related prosecutions are lower than those connected to other similar crimes, they become higher around the time of the introduction of the witness protection program for mafia cooperators. *PROSECUTION* related to Mafias registered a discrete shift upward in 1992, and then increased up to values around 2; in contrast, *PROSECUTION* relative to Others fluctuated around 1.

Local data for *PROSECUTION* are only available since 1993, thus preventing us to perform a more robust before-after analysis. Province-level data confirm, however, the evidence reported in Figure 6: the upward trending evolution of *PROSECUTION* for Mafias, after the introduction of the leniency program in 1991, is not shared by the pattern of *PROSECUTION* for Others. A formal evidence supporting this conclusion emerges by estimating the following equation:

$$PROSECUTION_{i,t} = a_i + ct + \varepsilon_{i,t},$$

---

[23]Note that the city of Milan is in the north of Italy while that of Rome is in the center of Italy. Calabria, Campania and Sicily are all located in the South.

[24]A prosecution cannot last for more than a year before either a trial begins, if there is enough evidence, or the case is closed — in few special cases an extra period of six months is admitted. Therefore, we construct our ratio by using the average value of crimes reported to the judicial authority by the police forces in two adjacent years as the denominator. The qualitative results do not change, however, if we consider only the contemporaneous year or the lagged one.

where i and t refer, respectively, to province and year, a_i is a province fixed effect, t is a deterministic trend, and $\varepsilon_{i,t}$ is an error term. OLS estimates of the parameter c, during 1993-2005, when *PROSECUTION* refers to either Mafias or Others are reported in Table 4. The column labelled "Core-regions" refers to a restricted sample, which contains only the provinces belonging to Campania, Puglia, Calabria and Sicily — i.e., those in which mafia-type organizations have been historically more pervasive. The column labelled "Rest of Italy" refers, instead, to the other Italian provinces.

When estimates are based on all provinces in Italy, the trend coefficient is estimated significantly different from zero — at 5% confidence level — only when *PROSECUTION* for Mafias is considered. If we restrict the sample to the Core-regions, a significant coefficient also emerges relative to *PROSECUTION* for Others. However, the point estimate is one-fourth of that related to *PROSECUTION* for Mafias. In fact, the coefficient c when Mafias (resp. Others) is considered is 0.116 (resp. 0.029); the corresponding t-ratio is 3.62 (resp. 2.15).[25] Hence, during the years following the introduction of the leniency program regarding mafia-type association crime prosecutions of such crime increased at a rate much higher than that relative to a similar crime.

Insert Table 4 here

Previous evidence is fully consistent with the idea that the leniency program have been positively affecting the probability of prosecutions of mafia crimes. Unfortunately, the data available do not allow to test if a structural break has taken place in 1991. The main drawback is that provincial data on prosecutions, acquittals and whistle-blowing are only available after the introduction of the program. Moreover, even if there was a break, in principle it may obey to the fact that resources were being shifted to fight the mafia around the same time of the introduction of the leniency program. The timing of the reform might have been endogenous; prosecutors might have noticed the drop in cohesion and increase in hostility among rival groups, and pushed for the introduction of the program precisely when this would have been most effective — i.e. when a large pool of disgruntled mobster were ready to defect. In this respect, it could be the case that the accomplice-witness program was approved in conjunction with other changes in law enforcement. Alternatively, the positive trend in prosecution rates for Mafias could have started before the introduction of the program, or even have caused the introduction of the program if, for example, it was driven by the emergence of a new class of more aggressive prosecutors.

A more direct test of the effectiveness of the leniency program, which is consistent with our model and robust to previous potential criticisms, relates to the circumstance that the accomplice-witness program should have induced a shift of prosecutions toward higher echelons of the organization. In fact, our model predicts that if a soldier talks, the boss is more likely to fall. This is a peculiar prediction of our model which is also less likely to be contaminated by simultaneous changes in resources. Although to take to the data this prediction in a systematic manner is not feasible, a simple look at the *very few* available data shows

---

[25] As expected, there is no statistically significant trend for the rest of Italy. We also test for the possibility of a structural change after the the 2001 reform of the accomplice-witness program. The null hypothesis however is not statistically significant at 5% level.

that this is exactly the case. Table 5 reports the number of 'latitanti pericolosi' (bosses) arrested during 1995-2005 together with the average stock of people participating the program during the same period.[26] Both variables are measured relative to the number of people prosecuted for mafia association. It emerges that there is a positive relationship between the number of bosses arrested and the pool of whistleblowers.

Insert Table 5 here

4.3 Propensity to whistle

A main prediction of our model is the negative correlation between the number of whistleblowers and the acquittal rate. Since the 2000 yearly data are available about the number of mafia accomplices who decide to cooperate with public prosecutors, thus joining the accomplice-witness program. In particular, the data allow to associate each accomplice with his former mafia group — labelled as Camorra, 'Ndrangheta, Sacra Corona Unita, Mafia, or Others — as well as to the judicial district where he has been prosecuted. We provide some evidence that the incentive to cooperate is related to the local legal environment. In particular, variations in the proportion of acquittals in mafia trials — across districts and through time — are exploited to reveal any impact of the perceived probability of being convicted on the number of whistleblowers.

The correlation of interest is formally identified by the following regression:

$$WHISTLEBLOWERS_{i,t} = a_0 + a_1 ACQUITTANCE_{i,t} + \varepsilon_{i,t}, \tag{7}$$

where $WHISTLEBLOWERS_{i,t}$ is the number of mafia affiliates prosecuted in the judicial district i and entering the program in year t, while $ACQUITTANCE_{i,t}$ is the proportion of people involved in mafia trials who was acquitted — i.e., the number of acquittals divided by the sum of acquittals and convictions.[27]

We argue that the $ACQUITTANCE$ variable may be a proxy for the perceived acquittal probability upon which mafia affiliates base their decision of blowing the whistle. Local differences in such probability account for our measure of differences in the inefficiency of the judicial system. This is because, a higher level of inefficiency is likely to imply a higher value of the perceived acquittal probability. Thus, under the assumption that $ACQUITTANCE_{i,t}$ is uncorrelated with $\varepsilon_{i,t}$, the coefficient a_1 identifies the effect of the inefficiency of the judicial system on the number of flipping criminals: we expect a negative sign for this coefficient.

However, we cannot neglect a possible reverse causality between $WHISTLEBLOWERS$ and $ACQUIT$-$TANCE$ since the cross-sectional variability of the former variable, which is partly due to historical differences among mafia groups, may affect that of the latter. Moreover, nation-wide correlation between the two variables may arise because of accidental correlation due to the short time span. Thus, it might be reasonable to assume that:

$$\varepsilon_{i,t} = v_i + \lambda_t + \eta_{i,t},$$

---

[26] We do not report data for the mafia cluster Sacra Corona Unita because of the very few number of bosses arrested (just 2).

[27] The crimes considered are those regulated by the *Codice di Procedura Penale* art. 51, comma 3 bis.

where v_i is a district-specific time-invariant component, possibly correlated with $ACQUITTANCE_{i,t}$, and λ_t is a time-specific effect. We take to the data this specification of the error term $\varepsilon_{i,t}$ in two alternative manners: by including district dummies among the regressors of equation (7) or by considering first-differences of the variables of interest. In any case we always allow for year dummies. By allowing for district dummies, we control for mafia-specific fixed factors, so that only within-district variability in whistleblowers contributes to the estimation of the acquittance's effect. When first-differences are considered, instead, the time-invariant component is removed from the estimated equation. The year dummies may also control for reverse causality at aggregate level and nation-wide variations in the efficiency of the judicial system.[28] Hence, overall our strategy should address the most likely endogeneity concern.

Table 6 reports the main results relative to all judicial districts characterized by at least 1 crime per year on average for $ACCUSATION$ — i.e., more than 8 crimes during the period — and to the subset of the 10 districts strongly troubled by the 4 main mafia groups. The time span is from 2000 to 2007. The first two columns rely on OLS with district dummies while the third and fourth columns refer to the first-difference specification. The estimated coefficient a_1 is always negative and it is statistically significant (5% level) when we restrict the sample to the core districts; in this case the point estimates are quite stable across specifications. Hence, as argued above, this suggests a positive relationship between the efficiency of the judicial system, as reflected by a higher conviction frequency, and the number of whistleblowers.

Previous conclusion is robust to the introduction of a number of controls. OLS estimates of a_1 very similar to those reported in table 6 are obtained by controlling for $MURDER$, the ratio between the number of mafia trials completed in a given year and the number of trials pending at the beginning of the year, as well as the total number of whistleblowers in the accomplice-witness program at the beginning of every year (results not reported).

Insert Table 6 here

Allowing for fixed effects controls for the main channel of endogeneity. However, if the information provided by whistleblowers at time t eventually affects the outcomes of future trials at $t + s$, then there can be some feedback from current $WHISTLEBLOWERS$ to future $ACQUITTANCE$. In this circumstance, both the dummy variables and first-difference approaches might deliver biased estimates. To take this problem into account, we exploit the prediction of our theoretical model and estimate an IV regression relying on the number of public officials (per capita) convicted for bribes at regional level, $CORRUPTION$. Actually, regressing $\Delta ACQUITTANCE$ on $\Delta CORRUPTION$ lagged emerges a negative and statistically significant coefficient (p-value 0.014), which is robust to the inclusion of year dummies, the lagged level of $ACQUIT$-$TANCE$ and the above set of controls. Thus, convictions for corruption and mafia related crimes tend to be

---

[28] A reasonable possibility is that the fraction of acquittals in mafia trials changes systematically depending on media coverage or political pressure. In principle, a high fraction could be due to very aggressive justice — because, for instance, the prosecutors are under strong political pressure — and a low one could be due to very cautious prosecutors, that only bring a case when it is really obvious that the mobster is guilty. Such sources of variations in enforcement mainly trigger off changes in $ACQUITTANCE$ during the time for the overall country. Thus, such an effect is to a large extent captured by the time dummies.

positively related as an increase of the former variable anticipates an expansion of mafia convictions. Given that, the first-difference version of equation (7) has been re-estimated by using $ACQUITTANCE_{i,t-1}$ and $\Delta CORRUPTION_{i,t-1}$ as instruments for $\Delta ACQUITTANCE_{i,t}$. The IV estimate of a_1 is still negative and substantially higher in absolute value than the corresponding OLS one: -26.12 (p-value less than 0.05).

The IV regression is indeed consistent with the possibility that corruption undermines the efficiency of the judicial system. If past convictions for corruption deter corruption itself in the future, then the higher is the number of convictions in the past, the larger is the *current* level of efficiency of the judicial system and (ceteris paribus) the lower should be the share of acquittances in mafia trials. In a nutshell, as mafia convictions tend to be more frequent after an increase of corruption convictions, this pattern supports the idea that mafia trials, and thus the incentive to whistle, may be affected by the diffusion of corruption.[29] Again the results are robust to the controls mentioned above.

5 Related Literature

Our analysis builds on, and is related to the literature on antitrust law enforcement studying the effects of leniency programs on cartels' formation in oligopoly. The first paper explicitly addressing the effects of leniency programs, and emphasizing their beneficial role, is Motta and Polo (2003).[30] They analyze the impact of reduced fines for cartel members that inform the antitrust authority and show that it can be efficient to reduce fines even when the authority has already started an investigation, but has not yet obtained evidence of misbehavior. However, this paper takes leniency rules as exogenous, while the identification of the optimal policy is a key point in our analysis. Following Rey (2003) and Spagnolo (2003), we also take into account the role of rewards to former criminals by studying their determinants and social value. As in their models, we also find that rewards are sometimes optimal. However, both these papers do not establish a link between internal cohesion of cartels and rewards, a prediction that, according to the evidence discussed in Section 2, is more specific to criminal organizations.

Another related paper is Chen and Rey (2007), which study the optimal design of leniency programs in a standard oligopoly framework. As Chen and Rey, we also take a mechanism design approach to leniency, but in a very different context: in contrast to them, we focus on leniency awarded after the investigation is opened (in this sense our analysis is closer to Motta and Polo, 2003). Aubert et al. (2006), analyze a model where leniency programs could have a positive social value insofar as they create a conflict of interests between members of different organizations (cartels or firms). They also discuss informally the idea that leniency programs could be desirable insofar as these laws generate conflicts between the members of the same organizations — e.g., firms. Our model is built precisely on this intuition but, in contrast to them, it

---

[29] Of course, we recognize that the result is puzzling if one interprets high numbers of corruption convictions in the past as a proxy for high level of corruption diffusion afterwards.

[30] Our paper also relates to the literature on plea bargaining, where 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 recent survey by Gazal-Ayal and Riza (2009). However, all these papers do not establish a link between internal cohesion of cartels and rewards, which is more specific to criminal organizations.

fully develops the formal arguments, and it identifies the main trade-offs at stake by shedding novel light on the available historical and empirical evidence. In particular, we make explicit the link between the degree of internal cohesion of a criminal organization and the social planner optimal policy.

Besides the leniency literature, our paper also relates to the literature on organized crime. This literature first focused on welfare comparisons between monopoly and competitive supply of bads – see for instance Buchanan (1973) and Backhaus (1979). More recently, Jennings (1984), Polo (1995), Konrad and Skaperdas (1997) and Garoupa (2000) have modelled criminal organizations as vertical structures where a principal must discipline its members.[31] We build on this literature by recognizing that members at various levels of the criminal chain have different bargaining power and, perhaps more importantly, face different prosecution risks, as they may be treated in different ways by the law, as well as by studying the role of accomplice-witness programs as a tool to exacerbate conflicts within criminal organizations.

In a recent theory paper Piccolo and Immordino (2012) assume that whistleblowers may have incentives to distort the information they provide, accusing innocents and delaying or derailing the investigations for good. Here, we kept theses issues aside in order to compare in the clearest possible way the main model's predictions.

Our analysis also shares important features with the literature on corruption.[32] Stemming from Becker and Stigler (1974) the law and enforcement literature has acknowledged that bribery reduces punishment and thus deterrence. To contrast this fall in deterrence, they propose the payment of efficiency wages to prevent bribe taking.[33] Bowles and Garoupa (1997) focus on the effects of bribery on the optimal allocation of public resources and they show that the maximal fine may not be optimal.[34] Polinsky and Shavell (2001) consider the dilution of deterrence caused by corruption not only due to bribing by criminals but also extortion of the innocent by enforcers. They propose rewards for corruption reports to mitigate the breakdown of deterrence. In a recent paper Kugler, Verdier and Zenou (2005) analyze an oligopoly model of criminal organizations, where the competing clans also engage in corruption. Differently from Bowles and Garoupa (1997), where a higher fine may deter crime but will encourage corruption, they find that the maximal fine is not optimal because it results in more rather than less crime. The role of corruption is not only in diluting deterrence but also as a strategic complement to crime — i.e., as a catalyst to crime. Finally, Buccirossi and Spagnolo (2006) highlight the potential perverse effect that awarding leniency to wrongdoers that self-report may have on opportunities for illegal cooperation. Our approach contributes to this literature in that we focus on the interaction between organized crime, corrupted public officials and leniency programs, showing that the fraction of criminals that cooperate and the optimal amnesty rate are both lower in the presence of a less corrupt justice.

The evidence presented on the evolution of prosecution rates and mafia murders is closely related to, and consistent with, the evaluation of the U.S. leniency program introduced by the Department of Justice in 1993 to fight cartels performed in Miller (2009). Our approach differs from Miller's in one main key respect:

---

[31]See also Fiorentini and Peltzman (1995), Mansour *et al.* (2006) and Baccara and Bar-Isaac (2008).

[32]See the survey by Polinsky and Shavell (2001) and more recently the one by Rose-Ackerman (2010).

[33]Besley and McLaren (1993) and Mookherjee and Png (1995) also propose efficiency wages to deter bribery.

[34]See also Basu et al. (1992), Marjit and Shi (1998).

contrary to many other crimes — e.g., cartels — the number of measured murders is close to the number of murders effectively committed. Thus, discovered murders are representative of the entire population, which eliminates the usual difficulty due to the confounding effect of the increased rate of detection (on the deterrence effect see also Ehrlich, 1981, Levitt, 1998, Harrington, 2008, and Harrington and Chang, 2009, among others). The fact that murders (differently from many other crimes) are measured correctly has been underlined by Marselli and Vannini (1997) in their study of Italian crime where they estimate a crime equation taking into account "a silent feature of the Italian context", that is the presence of criminal organizations.[35] In another recent empirical study, Brenner (2009) finds evidence that the 1996 EU leniency program has provided incentives to reveal information on criminal activities.

Finally, one of the main aspects that characterizes a criminal organization in our model is that the boss does not commit the crime but delegates its execution to the agent. This is clearly only one among the many other aspects of criminal organizations. Another aspect is, for instance, the fact that criminal organizations are hierarchical networks of relationships. In particular, in the network literature, there is a large debate about targeting "key players" in criminal organizations. Ballester et al. (2006, 2010), for instance, define the key player as the criminal who, once removed, leads to the highest aggregate crime reduction. This aspect is not present in our model where the criminal organization is represented simply as a principal-agent relationship. However, to the best of our knowledge, the link between leniency programs and "key players" has not yet been explored in this literature. We wish to address this new issue in future work.

6   Concluding remarks

Building on new evidence about Italian criminal organizations we have identified both the determinants and the main effects of accomplice-witness programs. Our analysis suggests that inducing former criminals to cooperate with the justice is particularly useful when the prosecution system is poorly efficient, criminal organizations have strong ties with public officials and the information provided by 'flipping criminals' is reliable. Consistent with the available historical evidence, our theoretical model suggests that the degree of cohesion between the members of a criminal organization is key for the design of the optimal leniency policy: rewards or even monetary benefits to informants are indeed sometimes necessary in the presence of organizations featuring strong cohesion between their members. The empirical evidence supports the idea that accomplice-witness regulations have a positive effect on prosecution as well as on deterrence. Moreover in line with our model prediction, the Italian experience seems to suggest that the inflow of accomplices is negatively correlated with a proxy of the inefficiency of the judicial system.

---

[35]However, their panel dataset of Italian regions for the period 1980 to 1989 gives no insights on the effect of the 1991 leniency program.

Appendix 1

Proof of Proposition 1. Differentiating the regulator's objective in $\mathcal{L}$ with respect to $\widehat{\delta}$ yields:

$$R_l'(\widehat{\delta}) = -(\overline{\theta} - \beta\underline{\theta})S_p g(\widehat{\delta}) + (1 - G(\widehat{\delta})) = \left[h(\widehat{\delta}) - (\overline{\theta} - \beta\underline{\theta})S_p\right] g(\widehat{\delta}),$$

where under **A1** the term in brackets is strictly decreasing. It follows that the regulator's objective is quasi-concave in $\widehat{\delta}$. Furthermore, $R_l'\left(\overline{\delta}\right) = -(\overline{\theta} - \beta\underline{\theta})S_p g\left(\overline{\delta}\right) < 0$ and $R_l'(\underline{\delta}) = \left[h(\underline{\delta}) - (\overline{\theta} - \beta\underline{\theta})\right] S_p g(\underline{\delta}) > 0$ under **A2**. It follows that the optimum is interior and thus characterized by the first-order condition (4). ∎

Proof of Proposition 2. The optimality condition (4) determines the proportion of informants:

$$1 - G(\widehat{\delta}^*) = 1 - G(h^{-1}((\overline{\theta} - \beta\underline{\theta})S_p)),$$

where $h\left(.\right)$ is decreasing under **A1**. This proportion of informants thus depends only upon (and increases with) $(\overline{\theta} - \beta\underline{\theta}S_p)$; that is, it increases with $\overline{\theta}$ and S_p and decreases if instead β or $\underline{\theta}$ increases.

From (3) and (4) we have:

$$\widehat{\delta}(\phi^*) = (1 - \phi^* - \beta p)S_a + L = h^{-1}((\overline{\theta} - \beta\underline{\theta})S_p),$$

or

$$\phi^* = 1 - \beta p - \frac{h^{-1}((\overline{\theta} - \beta\underline{\theta})S_p) - L}{S_a}.$$

It follows that ϕ^* increases with $\overline{\theta}$, S_p and L, and decreases when p, β or $\underline{\theta}$ increases. As for S_a, the conclusion follows from:

$$\frac{\partial \phi^*}{\partial S_a} = \frac{h^{-1}((\overline{\theta} - \beta\underline{\theta})S_p) - L}{S_a^2} = \frac{1 - \beta p - \phi^*}{S_a},$$

which concludes the proof. ∎

A simple two-whistleblowers model. In this section we extend the baseline model by considering the case where the criminal organization is formed by a boss and two (ex ante identical) fellows (each indexed by $i = 1, 2$) who jointly commit the crime and decide non-cooperatively whether to blow the whistle. The objective is to study how the optimal amnesty is affected by the presence of multiple agents owning complementary information that can be used against the boss. For brevity, and with no loss of insights, we assume that $\underline{\theta} = 0$ and $\alpha = \beta = p = 1$. We also posit that each fellow's personal cost of facing the trial (δ_i, $i = 1, 2$) is uniformly distributed over the support $[0, 1]$. The timing of the game is as follows.

t=1 Uncertainty about R resolves and the boss decides whether to commit the crime; if he chooses not to commit the crime, the game ends; otherwise the principal pays the wage w_i to each agent i once the crime is committed.

t=2 An investigation opens. Agents learn their personal costs of facing the trial (i.e., each fellow i learns only δ_i but not δ_{-i}) and, if a leniency program is in place, they simultaneously and non-cooperatively decide whether to blow the whistle. Depending on the legal regime, the trial uncertainty resolves, and sanctions (including the retaliation loss) are imposed.

As before, we assume that when only one agent blows the whistle, he obtains a discount ϕ, the boss is convicted with probability $\overline{\theta} < 1$, while the agent who has remained loyal to the organization is convicted

with probability 1. Moreover, following Chen and Rey (2007), we assume that when both fellows blow the whistle, each enjoys half of the full discount ϕ and the boss is convicted with probability $\sigma\bar{\theta}$. The parameter $\sigma \in [1, \min\{2, 1/\bar{\theta}\}]$ captures the degree of complementary between the information released by the two whistleblowers — i.e., if $\sigma = 1$ there is no complementarity at all and the boss' conviction risk is the same as when only one fellow cheats; if instead $\sigma > 1$ the boss' conviction risk is higher when both fellows cheat and this difference becomes larger the higher is σ (for $\sigma = 1/\bar{\theta}$ the boss is convicted with certainty if both talk; for $\sigma = 2$ the probability of convicting the boss doubles when both agents cheat relative to the case of a single cheat). Consistently with the previous analysis we assume that disloyalty is punished and that a whistleblower incurs the retribution loss L.

Since the fellows are ex ante identical, we look for a symmetric Bayesian Nash equilibrium: each agent blows the whistle if and only if his cost δ_i of facing the trial exceeds the threshold $\hat{\delta}$. Hence, agent i prefers to blow the whistle if and only if the following condition is met:

$$L + \Pr(\delta_{-i} \leq \hat{\delta})(1 - \phi)S_a + \Pr(\delta_{-i} > \hat{\delta})\left[1 - \frac{\phi}{2}\right]S_a \leq S_a + \delta_i, \tag{A1}$$

where the left-hand side is the expected loss from blowing the whistle (which depends on the behavior of the other agent), while the right-hand side is the cost of remaining loyal to the organization. Taken as an equality, condition (A1) identifies the threshold $\hat{\delta}$.

Hence, the wage paid by the boss to each agent is:

$$w(\hat{\delta}) = \int_0^{\hat{\delta}} [S_a + \delta_i]\, d\delta_i + \int_{\hat{\delta}}^1 \left[S_a + \hat{\delta}\right] d\delta_i,$$

while the boss' expected sanction is:

$$C(\hat{\delta}) = 2\hat{\delta}(1 - \hat{\delta})\bar{\theta}S_p + (1 - \hat{\delta})^2\sigma\bar{\theta}S_p$$

The Legislator's maximization program is thus

$$\max_{\hat{\delta}\in[0,1]} \left\{C(\hat{\delta}) + 2w(\hat{\delta})\right\} = \max_{\hat{\delta}\in[0,1]} \left\{2\hat{\delta}(1 - \hat{\delta})\bar{\theta}S_p + (1 - \hat{\delta})^2\sigma\bar{\theta}S_p + 2\left[\int_0^{\hat{\delta}} [S_a + \delta_i]\, d\delta_i + \int_{\hat{\delta}}^1 \left[S_a + \hat{\delta}\right] d\delta_i\right]\right\},$$

whose first-order necessary and sufficient condition is

$$2\left[\bar{\theta}S_p(1 - 2\hat{\delta}) - \bar{\theta}\sigma S_p(1 - \hat{\delta}) + (1 - \hat{\delta})\right] = 0. \tag{A2}$$

This condition suggests that there are again costs and benefits associated with a leniency policy. As in the baseline model, a too lenient policy (i.e., a low $\hat{\delta}$) may induce the boss to commit the crime more often because it reduces the agents' reservation wage. But, on the other hand, it may introduce ex-post conflict between the members of the organization that is detrimental to the boss insofar as it raises his conviction probability. Hence, both the dark and the bright sides of leniency discussed above are still at play here.

Notice that at $\hat{\delta} = 1$ this derivative is negative and equals to $-2S_p\bar{\theta}$, while at $\hat{\delta} = 0$ it equals to $2\left(1 - \bar{\theta}S_p(\sigma - 1)\right)$, which is positive if $1 > \bar{\theta}S_p(\sigma - 1)$. Hence, $1 > \bar{\theta}S_p(\sigma - 1)$ guarantees the existence of

an interior solution to the Legislator's problem. Solving (A2) with respect to $\widehat{\delta}$, the optimal policy requires

$$\widehat{\delta}^* = \frac{1 - \overline{\theta}S_p\,(\sigma - 1)}{1 - \overline{\theta}S_p\,(\sigma - 2)} \in (0,1)\,.$$

Using condition (A1), it follows that

$$\widehat{\delta}^* = \frac{2L - \phi S_a}{2 + \phi S_a},$$

so that the optimal amnesty is

$$\phi^*\,(\sigma) = \frac{\overline{\theta}S_p + L - 1}{S_a} + \frac{\left(L + \overline{\theta}S_p - 1 - 2\,(2 - \sigma)\,\overline{\theta}S_p\right)\overline{\theta}S_p}{\left((3 - 2\sigma)\,\overline{\theta}S_p + 2\right)S_a},$$

where, recall that the first term of the above equation, $\frac{\overline{\theta}S_p + L - 1}{S_a}$, is the optimal amnesty that one would obtain in the single-agent organization derived more generally in equation (5). It is easy to show that $\phi^*\,(\sigma)$ is increasing in σ — i.e., criminals that disclose complementary information are rewarded more intensively — and that

$$\phi^*\,(\sigma) > \frac{\overline{\theta}S_p + L - 1}{S_a} \quad \Leftrightarrow \quad \sigma > 2 - \frac{\overline{\theta}S_p + L - 1}{2\overline{\theta}S_p}.$$

When σ is not too large (i.e., $\sigma \to 1$) dealing with two informants has a relatively small impact on the boss' conviction risk. Hence, the Legislator has no incentive to induce both fellows to talk simultaneously, which requires setting a low amnesty. Indeed, even if each of them talks less often, it is optimal to slightly reduce the amnesty because the organization is larger and (ceteris paribus) the probability of whistleblowing is higher than in the single-agent case. When instead σ is away from 1, the Legislator wants to increase the amnesty because convicting the boss when both fellows talk is more likely than with a single whistleblower. Essentially, maximizing the probability of having more than one informant, requires to grant excessive amnesty ϕ relative to the single-agent case. ■

Appendix 2: Data

Mafia (malicious or intentional) murders: number of mafia murders reported by the police forces to the judicial authority. Source: Italian Institute of Statistics (ISTAT), Statistiche giudiziarie penali (several issues).

Malicious or intentional murders: total number of malicious murders, for reasons different than mafia, reported by the police forces to the judicial authority. Source: ISTAT, Statistiche giudiziarie penali (various issues).

Robberies in banks and post offices: number of robberies in banks and post offices reported by the police forces to the judicial authority. Source: ISTAT, Statistiche giudiziarie penali (various issues).

Kidnappings: number of kidnappings excluding those related to extortion reported by the police forces to the judicial authority. Source: ISTAT, Statistiche giudiziarie penali (various issues).

Prosecution of mafia-type association cases: number of cases of mafia association (art. 416-bis of the Italian penal code) prosecuted. Each prosecution is recorded according to the starting year, that is when the judicial authority begins the penal action. For each year the spatial distribution reflects the province where the crime prosecuted is presumed to be committed. Source: ISTAT, Statistiche giudiziarie (various issues).

People prosecuted for mafia crimes: total number of people prosecuted because of mafia crimes as indicated by the 'Codice di Procedura Penale', art. 51 comma 3 bis. Source: Italian Department of Justice.

Prosecution of criminal association cases: number of cases of criminal association (art. 416 of the Italian penal code) prosecuted. Each prosecution is recorded according to the starting year, that is when the judicial authority begins the penal action. For each year the spatial distribution reflects the province where the crime prosecuted is presumed to be committed. Source: ISTAT, Statistiche giudiziarie (various issues).

Mafia-type association accusation: number of cases of mafia association (art. 416-bis of the Italian penal code) reported by the police forces to the judicial authority. Source: ISTAT, Statistiche giudiziarie (various issues).

Criminal association crime accusation: number of cases of criminal association (art. 416 of the Italian penal code) reported by the police forces to the judicial authority. Source: ISTAT, Statistiche giudiziarie (various issues).

Whistleblowers: number of former mafia affiliates participating to the Italian accomplice-witness protection program. The dataset associates each accomplice with his former criminal organization (labelled as Camorra, 'Ndrangheta, Sacra Corona Unita and Mafia) and the judicial district of prosecution. Source: Commissione parlamentare d'inchiesta sul fenomeno della criminalità organizzata mafiosa o similare, technical report (various issues).

People convicted for mafia crimes and people acquitted: the number of people involved in trials — relative to mafia crimes as indicated by the 'Codice di Procedura Penale', art. 51, comma 3 bis — who end up to be convicted or acquitted. Spatial variability: 26 judicial districts. Source: Italian Department of Justice.

Trials pending and completed: the number of trials pending at the initial year or completed during the year — relative to mafia crimes as indicated by the 'Codice di Procedura Penale', art. 51, comma 3 bis. Spatial variability: 26 judicial districts. Source: Italian Department of Justice.

Municipality: local governments dismissed by the central government because of ties between administrators and the Mafia either through direct infiltrations of mobsters into the local administrations or by indirect influence. Source: Commissione parlamentare d'inchiesta sul fenomeno della criminalità organizzata mafiosa o similare, technical report (various issues).

Corruption: Public officials convicted because of bribery. Source: Alto Commissariato per la Lotta alla Corruzione. Data are relative to Italian regions during 1996-2006. Note that according to the Italian Penal Code, corruption crimes may be only committed by public officials and persons in charge of a public service.

References

[1] AUBERT, C., KOVACIC, W., AND REY P. (2006), "The Impact of Leniency and Whistleblowing Programs on Cartels," *International Journal of Industrial Organization*, 24: 1241-1266.

[2] ANDERSON, A. (1979), *The Business of Organised Crime: A Cosa Nostra Family*, Stanford, The Hoover Institution.

[3] ANSELMO, M., AND BRAUCCI, M. (2008), *Questa Corte Condanna: Spartacus, il Processo al Clan dei Casalesi*, edited by L'Ancora, Naples.

[4] BACCARA M., AND BAR-ISAAC, H. (2008), "How to Organise Crime," *Review of Economic Studies*, 75: 1039-1067.

[5] BACKHAUS, J. (1979), "Defending Organised Crime? A Note," *Journal of Legal Studies*, 8: 623-631.

[6] BALLESTER, C., CALVÓ-ARMENGOL, A. AND ZENOU, Y. (2006), "Who's who in networks. Wanted: the key player," *Econometrica,* 74: 1403-1417.

[7] BALLESTER, C., CALVÓ-ARMENGOL, A. AND ZENOU Y. (2010), "Delinquent networks," *Journal of the European Economic Association,* 8: 34-61.

[8] BANDIERA, O. (2003), "Land Reform, the Market for Protection, and the Origins of the Sicilian Mafia: Theory and Evidence," *Journal of Law, Economics and Organization,* 19: 218-244.

[9] BASU, K., BATTACHARYA, S., AND MISHRA, A. (1992), "Note on Bribery and the Control of Corruption," *Journal of Public Economics,* 38: 349-359.

[10] BECKER, G. (1968), "Crime and Punishment: an Aconomic Approach," *Journal of Political Economy,* 76: 169-217.

[11] BECKER G., AND STIGLER, G. (1974), "Law Enforcement, Malfeasance and the Compensation of Enforcers," *Journal of Legal Studies,* 3: 1-19.

[12] BESLEY, T., AND MACLAREN, J. (1993), "Taxes and Bribery: The Role of Wage Incentives," *Economic Journal,* 103: 119-41.

[13] BOWLES, R., AND GAROUPA, N. (1997), "Casual Police Corruption and the Economics of Crime," *International Review of Law and Economics,* 17: 75-87.

[14] BRENNER, S. (2009), "An Empirical Study of the European Corporate Leniency Program," *International Journal of Industrial Organization,* 27: 639-645.

[15] BUCCIROSSI, P. AND SPAGNOLO, G. (2006), "Leniency Policies and Illegal Transactions," *Journal of Public Economics*, 90: 1281–1297.

[16] BUCHANAN, J. (1973), "A Defense of Organised Crime?" in *The Economics of Crime and Punishment*, edited by S. Rottenberg, American Enterprise Institute.

[17] BUONANNO, P., DURANTE, R., PRAROLO, G. AND VANIN, P. (2012), "On the Historical and Geographic Origins of the Sicilian Mafia" mimeo.

[18] CANTONE, R. (2008), *Solo per Giustizia*, edited by Mondadori, Milano.

[19] CASSIDY, R. (2004), "Soft Words of Hope: Giglio, Accomplice Witnesses, and the Problem of Implied Inducements," *Northwestern University Law Review*, 98: 1129-1177.

[20] CHEN, Z., AND REY, P. (2007), "On the Design of Leniency Programs," mimeo TSE.

[21] DICKEY, J. (2004), *Cosa Nostra: A History of the Sicilian Mafia*, edited by Hodder & Stoughton.

[22] EHRLICH, I. (1981), "On the Usefulness of Controlling individuals: An Economic Analysis of Rehabilitation, Incapacitation, and Deterrence," *American Economic Review,* 71**:** 307–22.

[23] ELLIS, C. J. AND WILSON, W. (2001), "What Doesn't Kill us Makes us Stronger: An Analysis of Corporate Leniency Policy," Mimeo, University of Oregon.

[24] FALCONE, G. (1991), *Cose di Cosa Nostra,* edited by Rizzoli, Milano.

[25] FIORENTINI G., AND PELTZMAN, S. (1995), *The Economics of Organised Crime*, Cambridge University Press, Cambridge, and CEPR, 1-30.

[26] FORGIONE, F. (2008), *'Ndrangheta. Boss luoghi e affari della mafia più potente al mondo*, Baldini Castoldi Dalai.

[27] FYFE, N. AND SHEPTYCKI J. (2006), "International Trends in the Facilitation of Witness Co-operation in Organised Crime Cases," *European Journal of Criminology*, 3: 319-355.

[28] GAMBETTA, D. (1992), *La Mafia Siciliana,* edited by Einaudi, Torino.

[29] GAROUPA, N. (2000), "The Economics of Organised Crime and Optimal Law Enforcement," *Economic Inquiry,* 38: 278-288.

[30] GAZAL-AYAL, O. AND RIZA L. (2009), "Plea-Bargaining and Prosecution," in *Criminal Law and Economics,* edited by N., Garoupa, Edward Elgar Publishing.

[31] HARRINGTON, J., AND CHANG M. (2009), "Modelling the Birth and Death of Cartels with an Application to Evaluating Antitrust Policy", *Journal of the European Economic Association,* 7: 1400-1435.

[32] HARRINGTON, J. (2008), "Optimal Corporate Leniency Programs," *The Journal of Industrial Economics,* LVI: 215-246.

[33] KOBAYASHI, B. H. (1992), "Deterrence with Multiple Defendants: An Explanation for 'Unfair' Plea Bargains," *The RAND Journal of Economics,* 23: 507-517.

[34] KONRAD, K., AND SKAPERDAS, S. (1997), "Credible Threats in Extortion," *Journal of Economic Behavior and Organization*, 33: 23-39.

[35] KUGLER, M., VERDIER, T., AND ZENOU, Y. (2005), "Organised Crime, Corruption and Punishment," *Journal of Public Economics,* 89: 1639-1663.

[36] JENNINGS, W. (1984), "A Note on the Economics of Organised Crime," *Eastern Economic Journal*, 3: 315-321.

[37] LANDES, W. (1971), "An economic analysis of the courts," *Journal of Law and Economics*, 14: 61-107.

[38] LEVITT, S. (1996), "Why Do Increased Arrest Rates Appear to Reduce Crime: Deterrence, Incapacitation, or Measurement Error," *Economic Inquiry* 36: 353–72.

[39] LODATO, S. (2006), *Trent'Anni di Mafia*, edited by Rizzoli, Milano.

[40] MANSOUR, A., MARCEAU, N., AND MONGRAIN, S. (2006), "Gangs and Crime Deterrence," *Journal of Law Economics and Organization,* 22: 315-339.

[41] MARJIT, S., AND SHI, H. (1998), "On Controlling Crime with Corrupt Officials," *Journal of Economic Behavior and Organization,* 34: 163-172.

[42] MARSELLI, R., AND VANNINI, M. (1997), "Estimating a Crime Equation in the Presence of Organised Crime: Evidence from Italy," *International Review of Law and Economics,* 17: 89-113.

[43] MILLER, N. (2009), "Strategic Leniency and Cartel Enforcement," *American Economic Review*, 99: 750–68.

[44] MOOKHERJEE, D., AND PNG, I. (1995), "Corruptible Law Enforcers: How Should They Be Compensated?" *The Economic Journal*, 105: 145-159.

[45] MOTTA, M., AND POLO, M. (2003), "Leniency Programs and Cartel Prosecution," *International Journal of Industrial Organization,* 21: 347-379.

[46] PAOLI, L. (2003), *Mafia Brotherhoods: Organised Crime, Italian Style, New York*, Oxford University Press.

[47] PICCOLO, S., AND IMMORDINO, G. (2012) "Optimal accomplice-witnesses regulation under asymmetric information", CSEF working paper n.304.

[48] PINOTTI, P. (2011), "The Economic Consequences of Organized Crime: Evidence from Southern Italy," mimeo.

[49] POLINSKY, M., AND SHAVELL, S. (2001), "Corruption and Optimal Law Enforcement," *Journal of Public Economics,* 81: 1-24.

[50] POLO, M. (1995), "Internal Cohesion and Competition among Criminal Organizations," in *The Economics of Organised Crime,* edited by G., Fiorentini and S. Peltzman, Cambridge University Press, Cambridge, and CEPR, 87-109.

[51] REY, P. (2003), "Toward a Theory of Competition Policy," in Advances in *Economics and Econometrics: Theory and Applications*, Eighth World Congress, M. Dewatripont, L. P. Hansen, S. J. Turnovsky eds, Cambridge University Press.

[52] ROSE-ACKERMAN, S. (2010), "Corruption: Greed, Culture and the State," Yale Law & Economics Research Paper No. 409.

[53] SPAGNOLO, G. (2000), "Self-Defeating Antitrust Laws How Leniency Programs Solve Bertrand's Paradox and Enforce Collusion in Auctions," Fondazione Eni Enrico Mattei, Nota di Lavoro 52.2000.

[54] SPAGNOLO, G. (2003), "Optimal Deterrence Mechanisms against Cartels and Organised Crime," mimeo, Mannheim.

Table 1: CONVICTIONS FOR MAFIA AFFILIATION

	1982-1991	1992-1996	1997-2001	1982-2001
Campania	970	332	420	1722 (31.7%)
Calabria	150	168	229	547 (10.0%)
Puglia	35	245	396	676 (12.4%)
Sicily	229	681	1214	2124 (39.0%)
Rest of Italy	61	202	111	374 (6.9%)
Total	1445	1628	2370	5443 (100.0%)

Note: The table reports the total number of people convicted for mafia (art. 416-bis).

Table 2: WHISTLEBLOWERS AND CONFISCATION

	Whistleblowers		Confiscation	
	2008		1992-2007	
Camorra	294	35%	3,018	52%
'Ndrangheta	101	12%	308	5%
SCU	95	11%	190	3%
Sicilian Mafia	239	29%	1,878	32%
Others	104	13%	431	7%
Total	833	100%	5,826	100%

Note: Whistleblowers denotes the number of former mafia accomplices who were taking part the protection program at the end of 2008. Confiscation denotes the value (million of euros) of total assets confiscated.

Table 3: Top-5 provinces with most prosecutions

Mafia-type association (art. 416-bis)		Criminal association (art. 416)	
Provinces (Regions)	Prosecutions	Provinces (Regions)	Prosecutions
Palermo (Sicily)	476	Napoli (Campania)	1306
Napoli (Campania)	401	Roma (Lazio)	1125
Catania (Sicily)	286	Milano (Lombardia)	720
Catanzaro (Calabria)	262	Palermo (Sicily)	422
Caltanisetta (Sicily)	255	Bari (Puglia)	382

Note: The table reports the total number of crimes prosecuted during 1993-2005, relative to artt. 416 and 416-bis of the Italian penal code.

Table 4: Crimes Prosecuted after Leniency

	Mafia-type associations: art. 416-bis			Criminal associations: art. 416		
	Italy	Core-regions	Rest of Italy	Italy	Core-regions	Rest of Italy
Trend	0.053*	0.116**	-0.019	0.015	0.029*	0.011
	(2.05)	(3.62)	(-0.52)	(1.23)	(2.15)	(0.69)
N	620	281	339	1212	286	926

Note: The dependent variable is the ratio of the number of crimes prosecuted to the number of crimes accused by the police forces. For any t, the latter is the average of current and lagged accusations. Provincial dummies (not reported) are allowed. Time span: 1993-2005. Standard errors are robust to heteroschedasticity and intraprovince serial correlation (t-values are in parentheses). Significant coefficients are indicated by * $p<0.05$ and ** $p<0.01$.

Table 5: Bosses arrested and Whistleblowers

	Bosses	Whistleblowers
Camorra	12.54	20.43
Sicilian Mafia	20.29	24.54
'Ndrangheta	36.10	26.53

Note: The table reports the total number of bosses arrested (per 1000 people prosecuted for mafia association) and the average stock of whistleblowers (per 100 people prosecuted for mafia association) through 1995-2005.

Table 6: Incentives to become whistleblowers

	Levels specification		First-difference specification		
	All	Core	All	Core	Core
	OLS	OLS	OLS	OLS	IV
ACQUITTANCE	-1.85	-9.09*	-2.35	-8.44**	-26.12*
	(-1.36)	(-2.03)	(-1.49)	(-2.59)	(-2.46)
Year Dummies	Yes	Yes	Yes	Yes	Yes
Excluded Instruments (F-test)					8.92
Hansen J statistic					0.38
					(0.53)
Obs.-Districts	133-17	80-10	115-17	70-10	70-10

Note: The dependent variable is the number of whistleblowers. Results reported in the first two columns are based on variables in levels allowing for judicial district dummies; results reported in the last three columns are based instead on first-difference variables. 'All' refers to all judicial districts characterized by at least 1 crime per year on average for *ACCUSATION* while 'Core' refers to the subset of the 10 districts strongly troubled by the 4 main mafia groups. The t-values are in parentheses (standard errors are robust to heteroskedasticity); significant coefficients are indicated by * $p<0.05$, ** $p<0.01$.
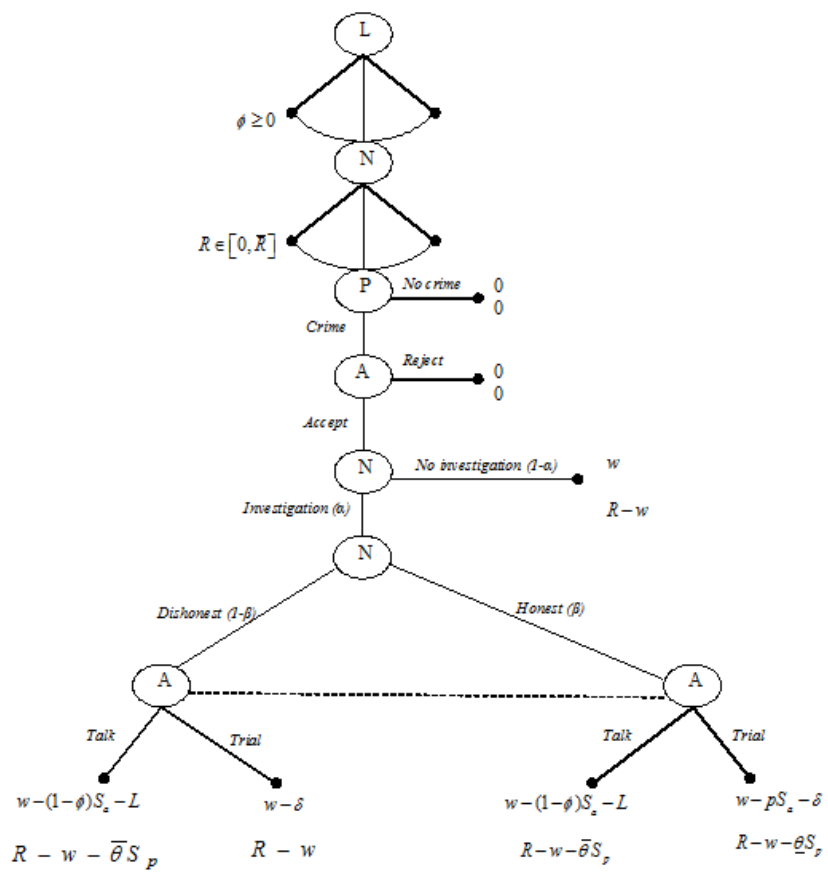
Figure 1: GAME TREE

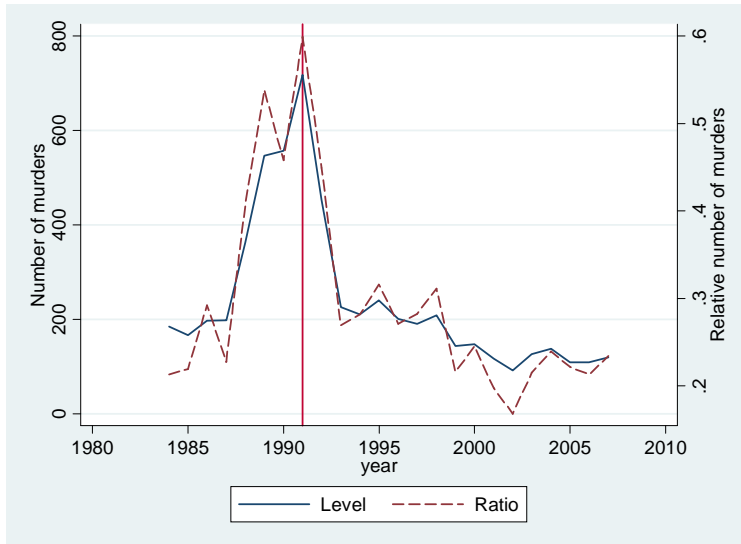Figure 2: MAFIA MURDERS IN ITALY

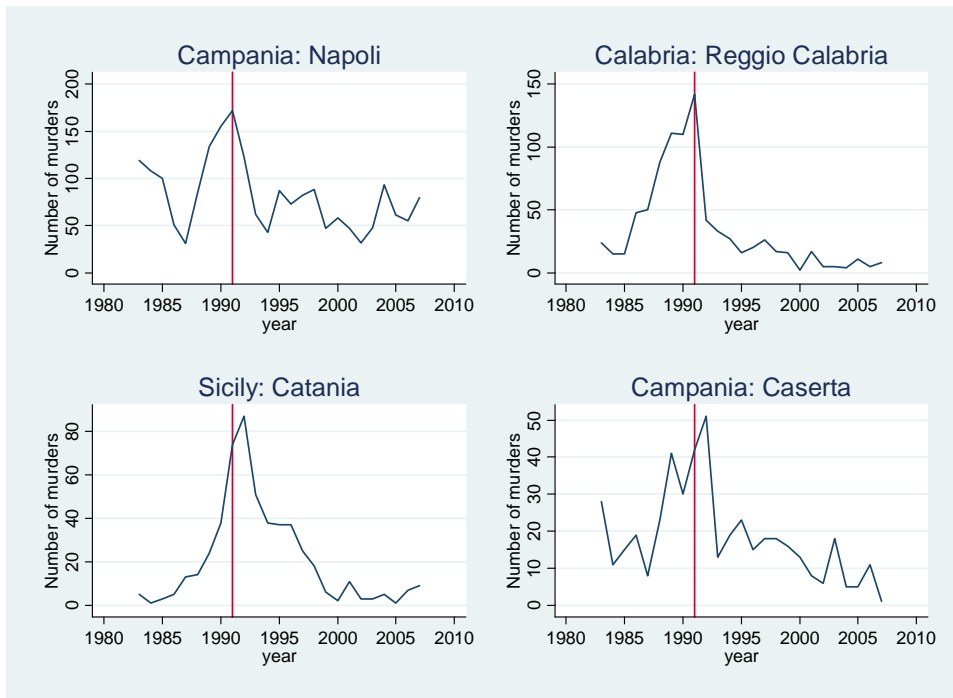Figure 3: PROVINCES WITH MOST MAFIA-RELATED MURDERS

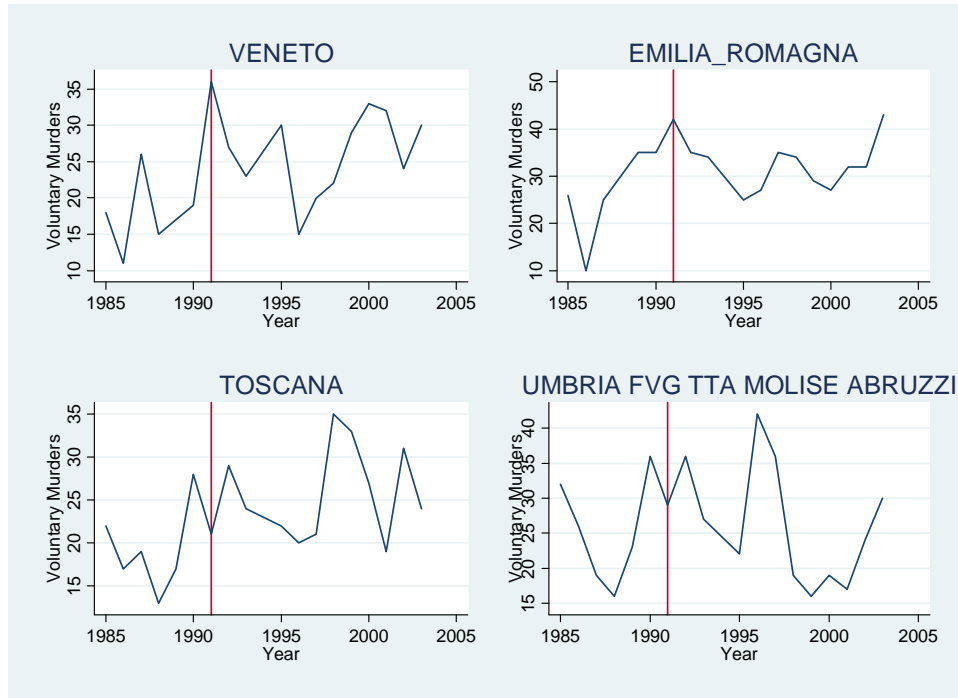Figure 4: MURDERS UNRELATED TO MAFIAS
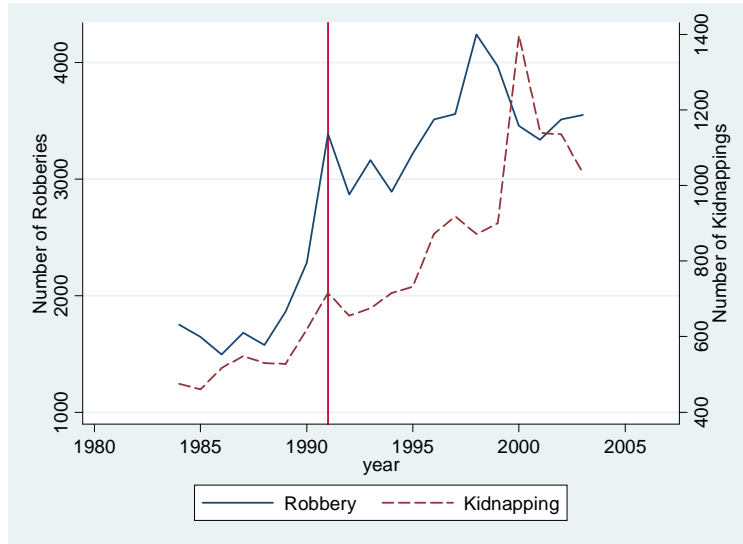

Figure 5: ROBBERIES AND KIDNAPPINGS IN ITALY

Figure 6: PROSECUTION AGAINST ORGANIZED CRIME IN ITALY