# From Anarchy to Monopoly: How Competition and Protection Shaped Mafia's Behavior

Luis G. Nardin*, Giulia Andrighetto*†, Rosaria Conte*, and Mario Paolucci*
*Institute of Cognitive Science and Technology (ISTC), Italian National Research Council (CNR), Rome, Italy
†European University Institute – Department of Political and Social Sciences, Fiesole, Italy
Email: {gustavo.nardin, giulia.andrighetto, rosaria.conte, mario.paolucci}@istc.cnr.it

***Abstract*—Mafia-like organizations are highly dynamic and organized criminal groups characterized by their extortive activities that impact societies and economies in different modes and magnitudes. This renders the understanding of how these organizations evolved an objective of both scientific and application-oriented interests. We propose an agent-based simulation model – the *Extortion Racket System* model – aimed at understanding the factors and processes explaining the successful settlement of the Sicilian Mafia in Southern Italy, and which may more generally account for the transition from an anarchical situation of uncoordinated extortion to a monopolistic social order. Our results show that in situations of anarchy, these organizations do not last long. This indicates that a monopolistic situation shall be preferred over anarchical ones. Competition is a necessary and sufficient condition for the emergence of a monopolistic situation. However, when competition is combined with protection, the resulting monopolistic regime presents features that make it even more preferable and sustainable for the targets.**

## I. Introduction

Mafia-like organizations are remarkably prosperous organizations originating in Southern Italy at the end of the XIX century, if not earlier, and now widely spread all over the country and the rest of the world. They are highly dynamic and organized criminal groups that impact societies and economies in different modes and magnitudes [1, 2]. However, their origins are not yet well understood, mainly due to the lack of information, which is in part a consequence of their secret nature.

Two alternative explanations of the origins of the Sicilian Mafia (henceforth *the Mafia*), one of the most known and successful mafia-like organization, have been proposed so far.

On the one hand, the Mafia has been considered as a specific way of thinking and behaving, and its origins are explained referring to the concept of *mafiosity*, a set of attitudes and values, i.e., a *subculture*, widespread in the Sicilian society [3–9].

An alternative explanation that has recently gained large support among scholars proposes two main factors explaining the origins of Mafia, (1) the *land reforms* and (2) the *property rights*. These factors were involved in the Sicilian transition from feudalism to pre-capitalism in the XIX century and in the typical market structure of the Sicilian region at that time [10–15].

Following to this view, the Mafia phenomenon developed when the State was weakly represented in the Sicilian region. Owing to the debate on the Italian Unification, the citizens kept their eyes wide open on Rome. Consequently, widespread criminal activities were freer to engage in repeated raids against properties and production, thereby creating a chaotic or anarchical situation all over Sicily.

Those criminal activities mainly consisted in the imposition of a predatory *taxation* on landowners, i.e., the extortion racket. The victims were forced to pay under the threat of harmful retaliation. Only if they did pay, they suffer no harm. Extortive activities were *uncoordinated* and the victims were exposed to the predatory requests of many *competing roving bandits* [16]. This situation induced landowners to hire reputable violent criminals to control banditry and protect their land and production [13].

This need for *protection*[1] increased the practice of *protection racketeering*, which is defined as "an institutionalized practice whereby tribute is collected on behalf of a criminal group that, in exchange, claims to offer (...) protection" [18, p. 140]. The activity of protection racketeering has been identified as the Mafia's typical activity [1, 12, 19, 20], which led Gambetta [12] to define it as "The Business of Private Protection."

Schelling [20] noted, however, that protection racket activities cannot tolerate co-existing extorters. Targets are less likely to pay more than one extorter per time. Successful racketeering seems to require a *monopolistic regime*[2]. Monopoly, in contrast to an anarchical situation of uncoordinated extortion, creates a sort of social order through which, once individuals accept to pay one extorter, they "do not need to worry about theft by others" [16].

Consequently, it becomes crucial to understand what are the factors leading to the achievement of monopolistic situations and what are the benefits that they may provide over anarchical ones. Another important issue is that of exploring what factors may lead to monopolistic situations that are more desirable for the societies in which extortion activities are endemic.

In our view, the understanding of how mafia-like organizations may have evolved from uncoordinated groups of *roving bandits* into real *governments of the underworld* is an objective of both scientific and application-oriented interests. On the

[1]There are different types of protection that extorters may provide to their victims, such as protection against themselves, against other rival extortionists, against business competitors (for a recent analysis of Mafia protection, see also [17]). In this work, we refer only to protection against other extortionists who would tax the same targets.

[2]By monopoly, we refer here to the presence on the territory of only one criminal organization practicing protection racketeering.

one hand, it aims to contribute to the general study of the bases and origins of social order [16, 21]; on the other, it aims to understand what makes mafia-like organizations so prosperous and successful: in Italy, criminal organizations of this type produce a huge tax-free capital, which is calculated to approximate 7% of the country's GDP in 2007 [22].

Hence, the present study proposes an agent-based simulation model – the *Extortion Racket System* model – aimed at understanding the factors and processes explaining the successful settlement of the Sicilian Mafia, which may more generally account for the transition from an anarchical situation of uncoordinated extortion (i.e., widespread banditry) to a monopolistic social order. The model will test the effects of the transition from a primitive and anarchical form of extortion to a monopolistic government of the underworld, both on the racketeering system and on the whole population.

The model involves the interplay between two types of agents – Extorters and Targets – and reproduces a situation in which rival extortive systems exist and compete with one another. Each extorter behaves according to an extortive policy that consists of the extortion level (i.e., the amount of the targets' endowment requested as extortion money) and punishment severity (i.e., the amount of punishment effectively inflicted by the extorter on the target that did not pay the extortion request). The extorters' goal is to extort the targets in their domain and to expand such domain by competing with other extorters, thereby providing a sort of *weak* protection to their targets. Alternatively, the extorters may reproduce a *strong* protection, in which they provide a more active shelter to their targets. The model enables the verification of the effects of competition among extorters on the extortion systems themselves and on the targets, as well as the observation of the separate and combined effects of both types of protection.

The Extortion Racket System model aims to test the following research questions:

1) How to explain the transition from an anarchical and uncoordinated extortive situation to a monopolistic one? What are the minimal factors that suffice to bring about a monopolistic regime?
2) What is the effect of either regime, anarchical and monopolistic, on the targets?
3) What is the effect of either regime on the extorters? In particular, what is the effect of the monopolistic regime on the profile and behavior of the surviving extorters?

We hypothesize that (1) a monopolistic regime is required for an extortion racket system to be successfully and steadily settled; (2) a monopolistic regime is preferred by the targets over an anarchical one; (3) the competition among extorters plays a key role in the transition from an anarchical and uncoordinated extortive situation to a monopolistic one; and (4) the strong protection enables the selection, among those competing, of the relatively most sustainable extortive system to become the monopolist.

As we will see, our results show that competition among extorters for defining and enlarging their domains leads to a monopolistic situation that generates advantages for both the targets and the extorters compared to an anarchical situation. In anarchical situations, the burden on targets is always greater than when a monopoly of any type is achieved. Moreover, anarchical situations of non-regulated extortion are shown to be not sustainable in the long-term since they are characterized by high rate of punishment, resulting in the rapid death of all targets and consequently of extorters. Results also show that when competition is combined with a strong protection, in which extorters that proved successful actively discourage their competitors from victimizing their own targets, advantages for the latter follow. In particular, a preferable monopolistic situation for the targets is achieved compared to the one achieved by competition alone: the presence of strong protection both speeds up the achievement of a monopolistic situation and favors the transition to a government of the underworld, in which the extortion burden and the level of punishment on targets decreases, while the number of survival targets increases.

The paper will unfold as follows. In Section II, we describe the Extortion Racket System model aimed to check the research questions we posed above. Next, we discuss the results we have obtained so far in Section III. Finally, we provide some conclusions as well as some ideas for future work in Section IV.

## II. Model Description

This simulation model represents a world populated by *extorters* and possible *targets* of extortion.

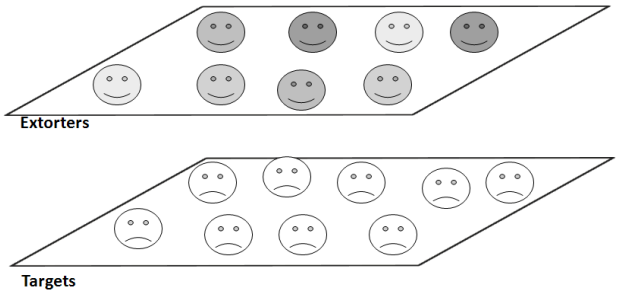



Fig. 1: Two-layer simulation model structure.

To help visualize our model, we structure it in two layers (see Figure 1). The top layer is populated with extorters ($E = \{e_1, \ldots, e_n\}$, where n is the total number of extorters in the model ($n = |E|$)), while the bottom layer with targets ($T = \{t_1, \ldots, t_m\}$, where m is the total number of targets in the model ($m = |T|$)). The extorters interact among themselves and with the targets for a specified number of *rounds*.

The extorters' basic activity is to extort targets and their goals are: (1) to receive extortion payment from as many targets as possible, and (2) to expand their domains as much as possible by providing protection to their targets.

Each extorter behaves according to its own extortive policy that remains unchanged over time. Each policy can be seen as an extorter's profile and consists in the combination of two traits: *extortion level* and *punishment severity*.

The extortion level refers to the amount of the targets' endowment requested under a more or less frightening menace, while the punishment severity represents the amount of punishment effectively inflicted by the extorter on the target in case of non-payment. Punishment is costly both to the target receiving it and to the extorter inflicting it as the extorter spends resources to inflict the punishment.

We characterize an extorter as an agent having the following set of attributes, see Table I.

TABLE I: Extorter's agent attributes.

| Attributes | Description |
|---|---|
| *Wealth* | Accumulated extortion received. |
| *Targets* | List of targets to extort. |
| *Enlargement Probability* | Probability of incorporating a new (randomly selected) target in the extorter's domain. |
| *Protection Provision* | Flag indicating whether the extorter tries or not to protect its targets from other extorters. |
| *Extortion Level* | Percentage of the target's income demanded as extortion. |
| *Punishment Severity* | Percentage of the target's income inflicted as punishment. |
| *Cost of Fighting* | Percentage of the extorter's wealth inflicted as cost on the opponent extorter. |
| *Cost of Punishing* | Percentage of the punishment inflicted paid as cost by the extorter. |

Targets are entrepreneurs that operate businesses (e.g., supermarkets, building companies, retail shops), which generate regular earnings. Their aim is to minimize the amount of earnings spent in paying extortion and in receiving punishment when not complying with the extortive request. Targets are agents with the following set of attributes, see Table II.

TABLE II: Target's agent attributes.

| Attributes | Description |
|---|---|
| *Wealth* | Accumulated income. |
| *Income* | Earning received at each round. |

Each target keeps also a record of the punishments and successful protections received from each of the extorters it interacted with. This piece of information is used by the target for ranking the extorters whenever it cannot afford paying all extortion requests (see Equation 1). Initially, the targets have just an estimation of the information, which they update whenever they have direct interactions with the extorters.

In the initialization simulation stage, the same number of targets is assigned to each extorter. The targets assigned to an extorter are referred to as the extorter's *domain*.

Assignment is performed according to the Pseudo-Algorithm 1, in which a new target randomly selected (line 4) is assigned to each extorter with a probability that varies according to the number of extorters already assigned to extort

**Pseudo-Algorithm 1** Initial definition of the extorters' domain.

```
1:  repeat
2:    for all extorter do
3:      while target not assigned do
4:        Select a target randomly
5:        if (target is not assigned to this extorter) then
6:          probability ← 1 / Number extorters assigned to
            this target
7:          if (random number < probability) then
8:            Assign target to this extorter
9:          end if
10:       end if
11:     end while
12:   end for
13: until all targets are assigned to more than one extorter
```

that specific target (line 6 – 9). This happens until all targets are assigned to more than one extorter (line 13).

This assignment procedure is aimed at reproducing an anarchical situation, characterized by all targets initially having more than one extorter demanding payment, and all extorters initially having the same number of targets to extort. The underlying idea is that prior to the Mafia consolidation, as evidence shows, there was no clear territorial separation among groups. Extorters needed to keep, defend, and expand their domains by competing with other extorters for the same limited resources (i.e., targets).

Each extorter's profile, consisting of the extortion level and punishment severity, is also defined in the initialization stage. The extortion level is randomly selected by applying a uniform distribution from 0% to 100%; also punishment severity is randomly selected on a uniform distribution, but the possibilities are limited between the extortion level value assigned to the extorter and 100%. For instance, if the extortion level randomly assigned to an extorter is 60%, then the punishment severity will be randomly selected from 60% to 100%.

Once completed the initialization stage, extorters and targets interact for several rounds, following the steps illustrated in Figure 2.

Each round begins with the targets receiving their incomes that result from regular business activities. This income varies among targets representing different businesses' type and size. In stage 1 (Figure 2), each extorter is assigned its own list of targets to extort, which represents its domain; however, it is also endowed with a given probability (*Enlargement Probability*, see Table I) to increase its domain by one new target. Once defined its new domain, extorters define how much to extort from each target (*Decide Extorting*, see Figure 2), which corresponds to the target's income multiplied by the extorter's extortion level. Then in stage 2, extorters make their extortive request to their targets (*Demand Extortion*, see Figure 2).

In the third stage (*Decide Paying Extortion*, see Figure 2), each target checks whether they can afford paying all the

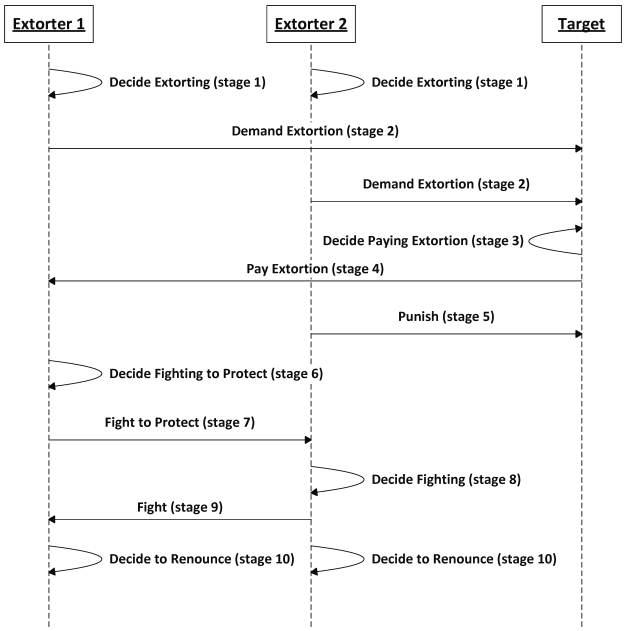



Fig. 2: Sequence diagram of the agents' interaction.

demanded extortions (i.e., they check whether their income is greater than or equal to the sum of all the extortions received). If so, it proceeds straight to stage 4 as it can afford paying all the extortion requests; otherwise, the target is forced to establish a preferential order among extorters. In order to rank them, the target assigns each extorter demanding extortion with a *convenience value* calculated according to Equation 1.

$$C_i = Ext_i + \left( \left( \sum_{j=1, i \neq j}^{n} Pun_j \times probPun_j \right) \times probProt_i \right) \quad (1)$$

where,

- $i$ and $j \in E$.
- $C_i$ is the *convenience value* assigned to extorter $i$.
- $Ext_i$ is the amount demanded as extortion by extorter $i$.
- $Pun_j$ is the punishment inflicted by extorter $j$ in case it does not receive the extortion payment.
- $probPun_j$ is the probability of the target being punished by extorter $j$ in case of non-payment of extortion. This probability is calculated based on the outcomes of previous interactions of this target with the same extorter $j$, considering those interactions in which the target has not paid the extorter $j$.
- $probProt_i$ is the probability of the target being protected by extorter $i$ in case the latter is paid. This probability is calculated based on the outcomes of previous interactions with the same extorter $i$ in which the latter successfully protected the target from extortions.

This convenience value is based on a simple algorithm aimed at minimizing the target's losses when selecting which extorters to pay. It combines the extortion demanded by the evaluated extorter and the potential protection service that the extorter may provide against other extorters. Based on the extorters' convenience value, the target sorts the extorters list in ascending order. It means that the target prefers to pay the lowest extortion and to receive the lowest punishment by all the unpaid extorters.

Then in stage 4, the target pays all or as many extorters it can afford to pay (*Pay Extortion*, see Figure 2), starting from the top to the bottom of its ranking extorters conveniences' list.

In stage 5, those extorters that did not receive payment decide whether to punish or not the targets that have not paid extortion (*Punish*, see Figure 2). The inflicted punishment reduces the target's wealth, but also imposes a cost on the punisher (*Cost of Punishing*, see Table I). Once punished, the target updates the extorters' punishment probability ($probPun_j$, see Equation 1). The incentive for punishing is the increased probability of the extortion's success in the next round.

Stages 6 and 7 depend on whether the *Provider Protection* extorter's attribute is enabled (see Table I). If so, the extorter goes through these stages; otherwise, it proceeds to stage 8, which means that the extorter does not provide strong protection to its targets.

In stage 6, extorters with the Provider Protection attribute enabled that received extortion payment (henceforth *protectors*) face a new decision, namely whether or not to fight against other extorters that tried to extort the same target (henceforth *opponents*) (*Decide Fighting to Protect*, see Figure 2). Fighting, which reproduces what we call strong protection, results in a reduced probability that one's targets will receive others' extortion demands in the future, and in a reduced risk that they will pay any of these [23]. The protector decides to fight only weaker or equally strong opponents, according to Equation 2.

$$\frac{wealth_p}{wealth_{max}} + \frac{numTarget_p}{numTarget_{max}} \geq \frac{wealth_o}{wealth_{max}} + \frac{numTarget_o}{numTarget_{max}} \quad (2)$$

where,

- $wealth_p$ and $numTarget_p$ are respectively the wealth and the number of targets of the protector extorter.
- $wealth_o$ and $numTarget_o$ are respectively the wealth and the number of targets of the opponent extorter.
- $wealth_{max}$ is the maximum of the protector and opponent extorters' wealth.
- $numTarget_{max}$ is the maximum of the protector and opponent extorters' number of targets.

If the protector decides to fight (*Fight to Protect*, see Figure 2), then in stage 7 both extorters suffer a reduction in their wealth (*Cost of Fighting*, see Table I) according to the Lanchester's N-Square rule [24, 25]. This rule states that when fighting, both extorters (protector and opponent) lose wealth, but each extorter loses wealth proportionate to the adversary's wealth. This means that the wealthier extorter has a greater impact on the less wealthy one, and there is no winner in such situation as both lose. The incentive for the protector to fight against its opponents is that of increasing the wealth difference between itself (stronger) and the opponent (weaker). This increased difference may then force the latter to give up

the target or die (i.e., successful protection). The emergent effect of strong protection is that of building a reputation of reliable protector.

In stage 8, unpaid extorters decide whether or not to fight against opponents (*Decide Fighting*, see Figure 2). This fighting decision is also based on Equation 2 in which the extorter decides to fight only weaker or equally strong opponents. The incentive for fighting is a resulting larger wealth difference from opponents, to the point that these might possibly quit the market. The long-term emergent effect is instead a reduced number of competitors, and finally a monopolistic situation in which both the targets and the extorters are better off than they are in an anarchical and uncoordinated regime. In stage 9, if the extorter decides to fight (*Fight*, see Figure 2) the cost of fighting is calculated also on the basis of the Lanchester's N-Square rule.

Finally, in stage 10 each extorter decides whether or not to renounce (*Decide to Renounce*, see Figure 2) the targets it unsuccessfully tried to extort. Renouncing means that the extorter will remove the targets from its domain. Three conditions must be satisfied for renouncing a target:

1) the extorter did not receive payment from the target;
2) the extorter was attacked by a protector of that target; and
3) the extorter did not attack anyone to protect that target.

If the extorter succeeds in leading others to renounce a target, or, otherwise stated, in protecting it, the target will keep track of this information and will update the protection probability concerning that extorter. This piece of information will obviously affect the target's ranking of future extorters (see Equation 1).

At the end of each round, the extorter dies if its wealth is not higher than 0 or if it has no targets to extort. In the former case, its targets will be redistributed to the extorters that fought for them. The target dies if its wealth is not higher than 0.

## III. Results and Discussion

This section describes a simulation experiment aimed at answering the posed research questions and check the validity of our hypotheses presented in Section I. The simulation experiment includes three treatments, as shown in Table III.

These treatments vary by just one feature. The *no-competition* treatment differs from the other two because extorters do not compete among themselves. By contrast, the *competition & no-strong-protection* and *competition & strong-protection* treatments differ as to the provision of the strong protection service to the targets. In the former treatment, extorters provide no active protection service to the targets: paid extorters do not fight against other possible extorters; in the latter treatment, the paid extorters have the option to provide active protection to their targets.

For each treatment, the simulation model was run 50 times with different random seeds and targets, but with the same set of extorters' profile randomly chosen once at the begin of the experiment. The input parameters used in the simulations are: extorters' profile (see Table IVa), extorters' attribute initial values (see Table IVb), and targets' attribute initial values (see Table IVc).

TABLE III: Experimental treatments.

| Treatment | Description |
|---|---|
| *No-Competition* | Extorters do not compete among themselves, meaning that they do not fight. Extorters demand extortion to the target and punish those that do not pay. |
| *Competition & No-Strong-Protection* | Extorters that receive extortion do not protect (*Protection Provision* disabled, see Table I) the extorted target from other extorters. Extorters that are not paid, first punish the targets that did not pay, and then decide whether to fight or not in order to increase the probability of expanding their domain. |
| *Competition & Strong-Protection* | Extorters that are paid may fight in order to protect their extorted targets (*Protection Provision* enabled, see Table I) and increase their chance of being paid in the future. Extorters that are not paid decide whether to fight or not in order to increase the probability of expanding their domain. |

TABLE IV: Input parameters.

(a) Extorters' profiles used in the experiment.

| Extortion Level | Punishment Severity |
|---|---|
| 70% | 90% |
| 30% | 40% |
| 80% | 100% |
| 90% | 100% |
| 40% | 50% |
| 60% | 70% |
| 80% | 90% |
| 100% | 100% |
| 20% | 20% |
| 50% | 70% |
| 60% | 90% |
| 10% | 60% |
| 20% | 90% |
| 30% | 70% |
| 70% | 80% |
| 50% | 50% |
| 10% | 20% |
| 40% | 100% |
| 100% | 100% |
| 90% | 90% |

(b) Extorters' attributes initial value.

| Attributes | Value |
|---|---|
| *Number of Extorters* | 20 |
| *Wealth* | 1000 |
| *Enlargement Probability* | 10% |
| *Targets* | 422 |
| *Cost of Fighting* | 3% |
| *Cost of Punishing* | 33.3% |

(c) Targets' attributes initial value.

| Attributes | Value |
|---|---|
| *Number of Targets* | 2000 |
| *Wealth* | 1000 |
| *Income* | Initialized with a base value chosen between 300 and 1000 using a uniform distribution. At each round, it varies this value from 90% to 110% |

This work has been realized within the FP7 European Project GLODERS and the input parameters' values have been inferred from empirical work conducted in Sicily by the GLODERS' partner affiliated with the University of Palermo [26, 27]. These data were collected through interviews of extorted entrepreneurs, judicial documents and confiscated Mafia documents analyses (e.g., the *Libro Mastro*, an accounting Mafia's book). These analyses corroborate the assumption that

the punishment severity inflicted by the Mafia in case of non-payment is often greater than the extortion demanded, as well as that the Mafia extortion request differs depending on the type of business extorted.

The analyses of the treatments are based on a set of output metrics described in Table V, which values are calculated as the average of the results of the 50 simulation runs carried on for each treatment.

TABLE V: Output metrics.

| Metric | Description |
|---|---|
| *Number of Extorters* | The number of extorters active on the simulation. |
| *Number of Targets* | The number of targets active on the simulation. |
| *Speed to Monopoly* | The number of rounds to achieve monopoly. |
| *Extortion Burden* | Proportion of the targets' income spent on paying extortion. |
| *Extortion x Punishment* | Proportion of demanded extortions that triggered punishment. |
| *Losses due to punishment* | Proportion of the targets' income lost because of punishment. |

Here is a summary of the main results. Figures 3a – 3d show the graphics of the dynamics of the *no-competition* (dotted line) and *competition & no-strong-protection* (solid line) treatments.

Due to the lack of competition among extorters in the *no-competition* treatment, targets face an anarchical situation in which they are exposed to requests from all possible extorters, causing their death, and consequently that of all extorters approximately at round 700.

In this treatment, targets' death is ignited at the beginning of the simulation as each target receives on average four extortive requests (this number is specific for the settings in Tables IVa – IVc and it may vary according to the ratio between targets and extorters). Thus targets that cannot bear to pay all of these demanded extortions are punished, and consequently many of them die, as the steep decrease in the number of targets of Figure 3b shows (from 2000 to around 500 targets in the initial rounds). In the subsequent rounds, the proportion of targets' income used to pay extortion increases (see Figure 3c), and the targets become incrementally unable to pay all of the extortive requests; this in turn inflates the number of punishments (see Figure 3d), and consequently the number of targets' deaths. As the number of targets diminishes, some extorters see their domains shrinking until they get to zero, what also causes their death. The situation evolves by the remaining extorters enlarging their domains, what slowly leads to the death of all the other targets and subsequently of the extorters.

The *no-competition* treatment represents a situation of predatory extortion, in which the extorters do not create any long-term relationship with their victims. They attempt to extort them, without caring about their survival. Moreover, they use violence as deterrence. Our results show that anarchical situations of non-regulated extortions are not sustainable in the long-term since they are characterized by predatory extortions and high levels of punishments, resulting in the rapid death of all targets and consequently of all extorters. Hence, as claimed by [16, p. 568] "In a world of roving banditry there is little or no incentive for anyone to produce or accumulate anything that may be stolen and, thus, little for bandits to steal.".

Instead, competition allows the situation to evolve from an anarchic violent situation to a regime of one stationary bandit (see the *competition & no-strong-protection* treatment in Figure 3a) who monopolizes the taxation (i.e., extortion), thus allowing for the emergence of a more acceptable situation for the targets. In it, only a portion of their income is stolen through extortion (see Figure 3c) and they do not have to worry about the theft of others [16][3]. In this sense, competition acts as a sort of weak or soft protection, in which targets, though victimized by one bandit, are at least freed from all others.

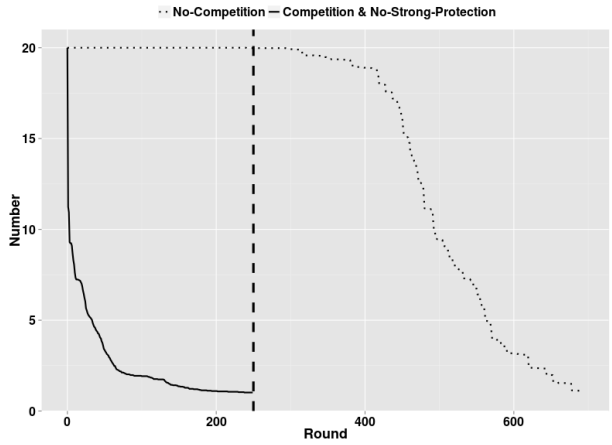
At the same time, competition selects among extortive systems, sorting out the successful ones. What makes an extorter succeed and survives competitors? The probability of obtain payment from targets. In turn, such a probability is determined by the extortion level: when this is reasonable [see 10], the targets are able to sustain the costs. Hence, no state of generalized violence, causing the death of all the targets, is triggered. Competition is an important factor of protection in two ways: (1) it brings about a monopolistic regime, which is more tolerable for targets than anarchy; (2) it leads to the selection of the most successful competitor, which turns to be the most likely to be paid, or, ultimately, to the extorter that makes the most acceptable requests. Competition among extorters seems a sufficient condition for a basic form of social order to settle.

Let us now compare the *competition & no-strong-protection* treatment's results with the *competition & strong-protection* ones.

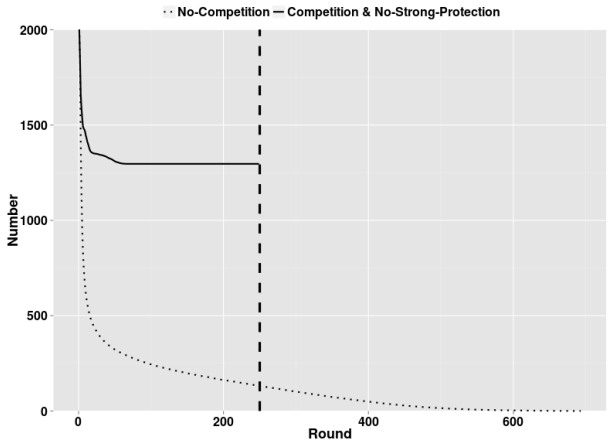
Figure 4a depicts the evolution of the number of extorters in the *no-strong-protection* (dotted line) and *strong-protection* (solid line) treatments. In both, the situation evolves from an anarchical into a monopolistic situation, determined by the survival of only one active extorter. In the former treatment, however, the monopolistic regime is reached in a shorter period of time, occurring approximately at round 90, while in the latter treatment, the same regime needs around 250 rounds to emerge. This time difference derives mostly from the fact that the activity of protection provision raises significantly the initial number of fights (see Figure 4e and Table VII) between extorters in comparison to the *no-strong-protection* treatment and consequently the number of extorters' death.

Besides reducing the frequency and severity of violence and

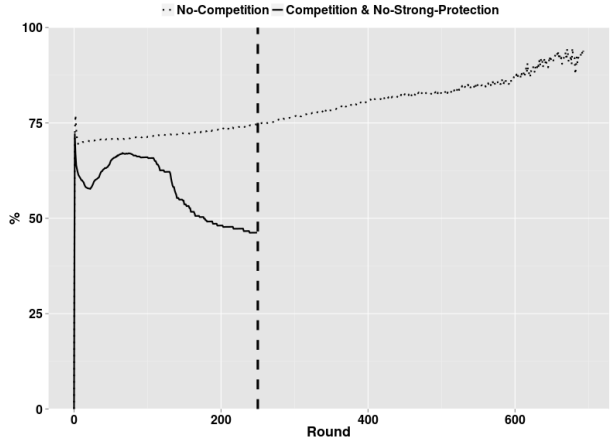
[3]Once a monopoly is achieved, the monopolistic extorter may have an incentive to increase the extortion demand, which may create a favorable environment for the emergence of other competing extorters leading to the competition dynamics once again. Even though this is an interesting aspect to analyze, this work focuses only on the process leading to monopoly achievement, not in its evolution after the achievement.



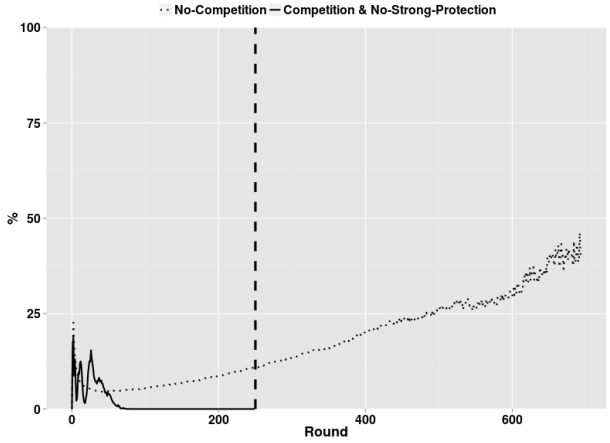

(a) Number of Extorters.




(b) Number of Targets.




(c) Proportion of target's income spent on paying extortion.




(d) Proportion of extortions demanded that resulted in punishment.

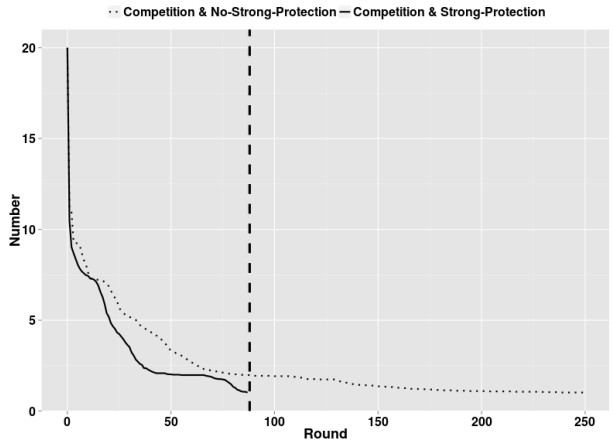
Fig. 3: Dynamics of *no-competition* (dotted line) and *competition & no-strong-protection* (solid line) treatments. The vertical dashed line in the graphics indicates the moment in which a monopolistic regime is achieved in one of the treatments. By this, we mean a situation in which there is only one active extorter in the environment. The $x$-axis unit of all the graphics indicates the number of simulation rounds.

the time needed to reach monopoly, strong protection has further positive effects on targets. As shown in Figures 4d and 4f, strong protection results in a reduced, respectively, frequency and severity of punishment inflicted on the targets that refused to pay. It therefore makes the number of surviving targets increase (see Figure 4b), and leads to an increasing amount of resources targets are left with, after they have paid extortions (see Figure 4c). Additionally, Figure 4c also shows that after the monopoly has been achieved, the level of extortion requested is higher with strong protection than without. This seems to indicate that strong protection makes the extortion burden more tolerable for targets, and the power of successful extorters more stable.

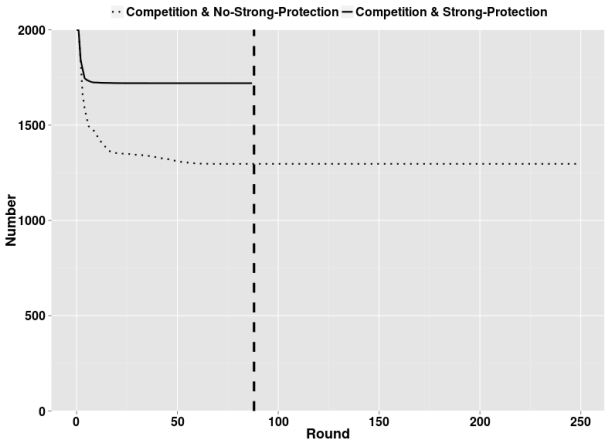
Analyzing numerically the effects of only competition vs competition plus strong protection with respect to the metrics affecting targets' welfare, we observe a statistical significant improvement for all of them (see Table VI, column Student's T-Test p-value). An interesting finding noticeable in Table VI is that not only the targets benefit from active protection provided by extorters, but also the monopolistic extorter benefits from it, as its wealth is 55.43% larger in the latter treatment.

Entering in more details about the monopolistic extorters, Tables VII and VIII show the ranking of extorters beginning from the extorter that survived longest to the extorter that survived the least, respectively in the *no-strong-protection* and *strong-protection* treatments. The main difference between these treatments is the number of punishments inflicted to the targets that resist paying extortion, which is always significantly lower in the protection treatment than in the non-protection treatment. Exceptions are the last 8 extorters, which in both treatments have a short life, only 2 rounds, showing that there is an early elimination of extorters with an exceeding extortive demand (higher than or equal to 70%).

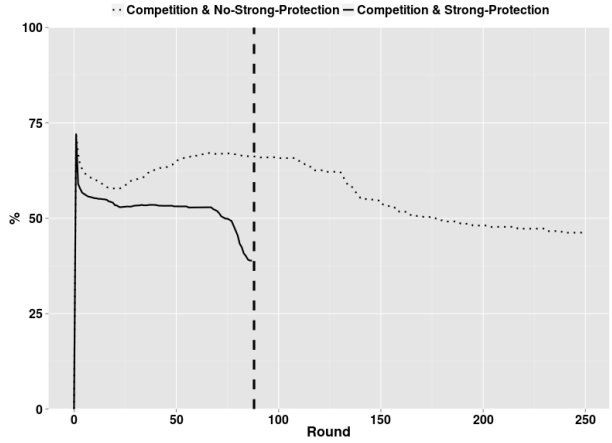
Another interesting difference between these two treatments



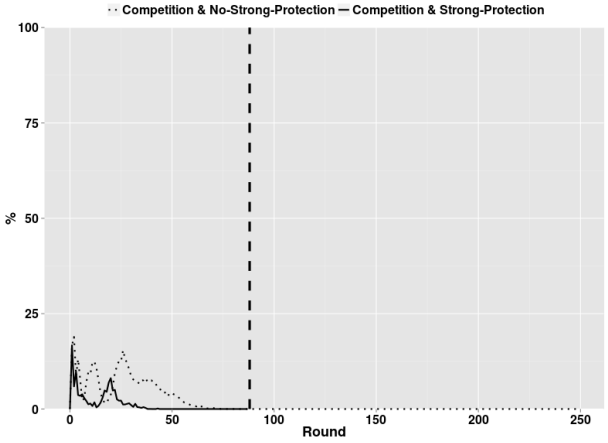

(a) Number of Extorters.



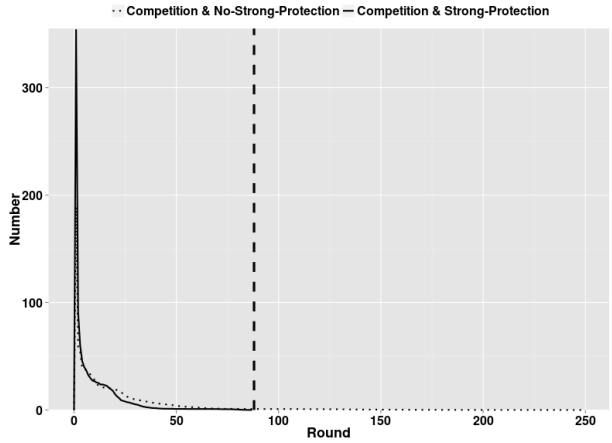

(b) Number of Targets.



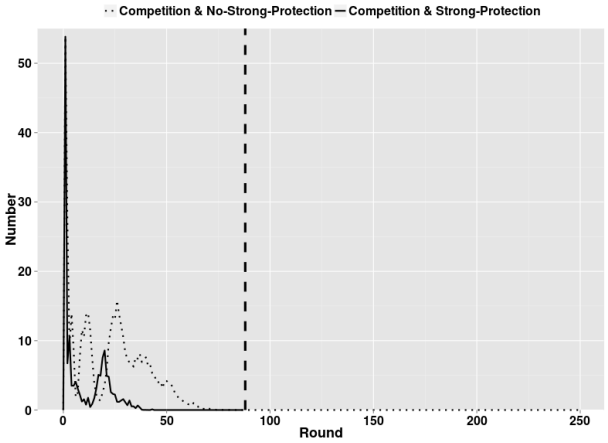

(c) Proportion of target's income spent on paying extortion.




(d) Proportion of extortions demanded that resulted in punishment.




(e) Number of fights among extorters.




(f) Severity of punishment inflicted.

Fig. 4: Dynamics of *competition & no-strong-protection* (dotted line) and *competition & strong-protection* (solid line) treatments. The vertical dashed line in the graphics indicates the moment in which a monopolistic regime is achieved in one of the treatments. By this, we mean a situation in which there is only one active extorter in the environment. The $x$-axis unit of all the graphics indicates the number of simulation rounds.

TABLE VI: Output metrics considered for the analysis of the model.

| Metric | Competition & No-Protection | | Competition & Protection | | Student's T-Test |
|---|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation | p-value ($\alpha$ = 0.05) |
| Number of Alive Targets | 1,296.52 | 61.62 | 1,719.68 | 35.22 | $2.2 \times 10^{-16}$ |
| Total Wealth of Alive Targets | 99,959,199.00 | 15,759,955.00 | 178,787,543.00 | 535,7493.00 | $2.2 \times 10^{-16}$ |
| Wealth of the Monopolistic Extorter | 64,198,555.00 | 16,581,454.00 | 99,790,153.00 | 381,1173.00 | $2.2 \times 10^{-16}$ |

TABLE VII: Rank of extorters in the *competition & no-strong-protection* treatment.

| Rank | Extortion Level | Punishment Severity | Number of Punishments | Extortion x Punishment |
|---|---|---|---|---|
| 1 | 40% | 100% | 432.1 | 0.59% |
| 2 | 60% | 90% | 1533.8 | 4.05% |
| 3 | 50% | 50% | 1978.26 | 21.91% |
| 4 | 50% | 70% | 2918.34 | 3.43% |
| 5 | 40% | 50% | 1246.96 | 4.02% |
| 6 | 30% | 70% | 404.88 | 1.95% |
| 7 | 30% | 40% | 490.88 | 2.84% |
| 8 | 60% | 70% | 723.46 | 36.17% |
| 9 | 20% | 90% | 74.34 | 0.81% |
| 10 | 20% | 20% | 239.96 | 3.59% |
| 11 | 10% | 60% | 30.1 | 0.87% |
| 12 | 10% | 20% | 68.62 | 2.03% |
| 13 | 100% | 100% | 442.5 | 24.98% |
| 14 | 80% | 100% | 423.06 | 23.86% |
| 15 | 90% | 90% | 438.74 | 24.81% |
| 16 | 70% | 80% | 393.92 | 22.19% |
| 17 | 100% | 100% | 442.96 | 25.00% |
| 18 | 90% | 100% | 438.22 | 24.72% |
| 19 | 80% | 90% | 429.52 | 24.23% |
| 20 | 70% | 90% | 361.28 | 20.34% |

TABLE VIII: Rank of extorters in the *competition & strong-protection* treatment.

| Rank | Extortion Level | Punishment Severity | Number of Punishments | Extortion x Punishment |
|---|---|---|---|---|
| 1 | 40% | 100% | 43.2 | 0.04% |
| 2 | 30% | 70% | 114.2 | 0.12% |
| 3 | 50% | 70% | 843.94 | 3.36% |
| 4 | 60% | 90% | 845.72 | 3.74% |
| 5 | 40% | 50% | 679.26 | 2.96% |
| 6 | 30% | 40% | 246.32 | 1.53% |
| 7 | 20% | 90% | 18.62 | 0.12% |
| 8 | 50% | 50% | 410.08 | 17.56% |
| 9 | 20% | 20% | 122.16 | 2.05% |
| 10 | 10% | 60% | 9.62 | 0.33% |
| 11 | 60% | 70% | 321.14 | 18.22% |
| 12 | 10% | 20% | 15.42 | 0.58% |
| 13 | 100% | 100% | 442.5 | 24.98% |
| 14 | 90% | 90% | 423.18 | 23.87% |
| 15 | 80% | 100% | 439.88 | 24.82% |
| 16 | 70% | 80% | 393.88 | 22.19% |
| 17 | 100% | 100% | 442.96 | 25.00% |
| 18 | 90% | 100% | 438.28 | 24.73% |
| 19 | 80% | 90% | 429.22 | 24.21% |
| 20 | 70% | 90% | 361.12 | 20.33% |

is the ranking position of high punishers, which is always lower in the *strong-protection* treatment than in the *no-strong-protection* treatment. This means that in the former treatment the most violent extorters (i.e., those that punish more severely) are eliminated earlier than in the case when *strong-protection* is not available, thus significantly reducing the targets' losses (i.e., amount of wealth spent on paying punishment, see Figure 4c).

## IV. Conclusion and Future Work

The Extortion Racket System model is aimed at understanding how social order may emerge from anarchical situation of uncoordinated extortion (i.e., widespread banditry). It focuses on the factors and processes that may lead from an anarchical and chaotic situation to a monopolistic social order, in particular, it is aimed at answering some research questions, by testing the following 4 hypotheses: (1) a monopolistic regime is required for an extortion racket system to be successfully and steadily settled; (2) a monopolistic regime is preferred by the targets over an anarchical one; (3) the competition among extorters plays a key role in the transition from an anarchical and uncoordinated extortive situation to a monopolistic one; and (4) the strong protection enables the selection, among those competing, of the relatively most sustainable extortive system to become the monopolist.

Our results show that in situations of anarchy, extortion racket systems do not last long: they dissolve soon because they cannot sustain the rebellion and consequent death of their targets (Hypothesis 1). Moreover, the level of extortion paid by the targets is always lower whenever a monopoly of any type is achieved. This results in a situation in which both the monopolistic extorter and the targets are better off: targets do not need to worry about the thefts of other extorters, they are left with a certain capital after paying the extortion, and therefore have an incentive to save and to invest, thereby increasing future income that the extorter can benefit from. Monopolistic situation shall then be preferred over anarchical ones, because as claimed by Olson [16, p. 568] "In a world of roving banditry there is little or no incentive for anyone to produce or accumulate anything that may be stolen and, thus, little for bandits to steal." (Hypothesis 2).

Moreover, results show that competition is a necessary and sufficient condition for the emergence of a monopolistic situation (Hypothesis 3). However, when competition is combined with strong protection, the resulting monopolistic regime

presents features that make it more preferable and sustainable for the targets than the one emerging from competition alone. The strong protection of the subjects against other possible extorters favors the rapid emergence of a government of the underworld in which a peaceful order is provided (since less punishment has to be used to convince targets to pay) and more resources are left to the targets (Hypothesis 4).

In future work, we intend to enable agents to improve their performance by dynamically adapting their extortive demands and punishment severity (i.e., their profile) to the context in which they interact. Additionally, we may enable them to form coalitions instead of only competing among themselves, which may enable the representation and analysis of different types of mafia-like organizations, such as *'Ndrangheta* and *Camorra*. We also may enable the entry of new extorters that may challenge the dominance of a monopolist in order to validate the dominant resistance against new comers.

## Appendix
## Glossary

Follows a glossary with the definition of the most important concepts used in the paper.

- *Anarchy* is characterized by a target having more than one extorter demanding extortion payment.
- *Monopoly* is characterized by the presence on the territory of only one extortion system practicing racketeering.
- *Extortion Level* is the amount of the targets' endowment requested as extortion money.
- *Punishment Severity* is the amount of punishment inflicted by the extorter on the target that did not pay extortion.
- *Fighting* is a situation in which an extorter attempts of harming or gaining power over another extorter.
- *Competition* (or weak protection) is the fight started by an extorter that *did not* receive extortion payment.
- *Protection* (or strong protection) is the fight started by an extorter that *did* receive extortion payment. Strong protection provides a more active shelter to its targets compared to competition (weak protection).

## Acknowledgment

This work is partially funded by the FP7 Project GLODERS (FP7/2007-2013). Grant Agreement Number 315874.

## References

[1] A. La Spina, *I costi dell'illegalità: Mafia ed estorsioni in Sicilia*. Il Molino, 2008.

[2] P. Pinotti, "The economic costs of organized crime: Evidence from southern Italy," Bank of Italy, Economic Research and International Relations Area, Temi di discussione (Economic working papers) 868, 2012.

[3] G. Pitrè, *Usi e costumi, credenze e pregiudizi del popolo siciliano*. L. Pedone Lauriel di Carlo Clausen, 1889, vol. 1.

[4] H. Hess, *Mafia and mafiosi: The structure of power*. Lexington Books, 1973.

[5] A. Blok, *The mafia of a Sicilian village, 1860-1960: A study of violent peasant entrepreneurs*, ser. Pavilion. Waveland Press, 1974.

[6] J. Schneider and P. T. Schneider, *Culture and political economy in western Sicily*. Academic Press, 1976.

[7] L. J. Rial, "Social desintegration and liberal authority: The Sicilian experience of national government, 1860 - 1866," Ph.D. dissertation, Cambridge University, 1988.

[8] P. Pezzino, "Origini e svolgimenti dei fenomeni di mafia," in *Proceedings of Mafia, 'Ndrangheta e Camorra dall'Ottocento a Oggi*, 1989.

[9] G. Fulvetti, "The mafia and the problem of the mafia: Organised crime in italy, 1820-1970," in *Organised Crime in Europe*, ser. Studies Of Organized Crime, C. Fijnaut and L. Paoli, Eds. Springer, 2004, vol. 4, pp. 47–75. [Online]. Available: http://dx.doi.org/10.1007/978-1-4020-2765-9_2

[10] L. Franchetti, *Condizioni politiche e amministrative della Sicilia*. G. Barbèra, 1877.

[11] G. Servadio, *Mafioso: A history of the Mafia from its origins to the present day*. Secker & Warburg, 1976.

[12] D. Gambetta, *The Sicilian mafia: The business of private protection*. Harvard University Press, 1993.

[13] O. Bandiera, "Land reform, the market for protection, and the origins of the Sicilian mafia: Theory and evidence," *Journal of Law, Economics and Organization*, vol. 19, no. 1, pp. 218–244, 2003.

[14] A. Dimico, A. Isopi, and O. Olsson, "Origins of the Sicilian mafia: The market for lemons," University of Gothenburg, Department of Economics, Working Papers in Economics 532, 2012.

[15] P. Buonanno, R. Durante, G. Prarolo, and P. Vanin, "On the historical and geographic origins of the Sicilian mafia," University Library of Munich, Germany, Tech. Rep., 2012.

[16] M. Olson, "Dictatorship, democracy, and development," *The American Political Science Review*, vol. 87, no. 3, pp. 567–576, 1993.

[17] F. Varese, "Protection and extortion," in *Oxford Handbooks Online*. Oxford University Press, 2013. [Online]. Available: http://dx.doi.org/10.1093/oxfordhb/9780199730445.013.020

[18] V. Volkov, *Violent entrepreneurs: The use of force in the making of Russian capitalism*. Cornell University Press, 2002.

[19] G. L. Hostetter and T. Q. Beesley, *It's a racket!* Les Quin Books Inc., 1929.

[20] T. C. Schelling, "What is the business of organized crime?" *The American Scholar*, vol. 40, no. 4, pp. 643–652, 1971.

[21] C. Tilly, "War making and state making as organized crime," in *Bringing the State Back In*, P. Evans, D. Rueschemeyer, and T. Skocpol, Eds. Cambridge: Cambridge University Press, 1985, pp. 169–191. [Online]. Available: http://dx.doi.org/10.1017/CBO9780511628283.008

[22] G. Barone and G. Narciso, "The effect of mafia on public transfers," The Rimini Centre for Economic Analysis, Working Paper Series, 2013.

[23] P. Reuter, *Racketeering in legitimate industries: A study in the economics of intimidation*. RAND Corporation, 1987.

[24] F. W. Lanchester, *Aircraft in warfare: The dawn of the fourth arm*. Constable, 1916.

[25] ——, *The World of Mathematics*. Simon and Schuster, 1956, vol. 4, ch. Mathematics in Warfare, pp. 2138–2157.

[26] V. Militello, A. La Spina, G. Frazzica, V. Punzo, and A. Scaglione, "Quali-quantitative summary of data on extortion rackets in Sicily," GLODERS Project, Deliverable 1.1, 2014. [Online]. Available: http://www.gloders.eu/images/Deliverables/GLODERS_D1-1.pdf

[27] A. La Spina, G. Frazzica, V. Punzo, and A. Scaglione, "How mafia works. an analysis of the extortion racket system." in *Proceedings of ECPR General Conference*, 2014, to appear.