WINPEC Working Paper Series No.E1717
September 2017

Optimal law enforcement with oligopolistic criminal organizations and violent conflict

Ken Yahagi

July, 13, 2017

Waseda INstitute of Political EConomy
Waseda University
Tokyo,Japan

Optimal law enforcement with oligopolistic criminal organizations and violent conflict

Ken Yahagi *

July 13, 2017

Abstract

This paper develops a model of oligopolistic criminal organizations (Mafias) that regulate the criminal market by extortion. This paper shows that Mafias may contribute to social welfare improvement as long as they can work as regulators in the criminal market. However, it is difficult to keep oligopolistic Mafias because of their violent conflicts. This paper explores the relationship between harsh penalties and an economic incentive for violent conflict. This paper shows that harsh penalties may cause either more or less violence and crime, depending on whether the Mafias can act as regulators. This paper also provides an explanation for the behavior of Japanese Mafias (Yakuza).

keywords: Conflict, Oligopoly, Organized Crime

JEL Classification: D74, K4, L13,

*Graduate School of Economics, Waseda University, 1-6-1, Nishiwaseda, Shinjuku-ku, Tokyo, 169-8050, Japan. Email: yhgkn@moegi.waseda.jp

1 Introduction

The literature on the economics of crime has focused on the problem of a rational individual deciding whether to engage in criminal activities. This line of analysis was initiated with Becker's (1968) seminal work. Based on Becker's approach, many researchers have tried to determine the optimal deterrence policy that the government should adopt and its effect on social welfare and efficiency. See Garoupa (1997) and Polinsky and Shavell (2000) for overviews.

Even if organized crime is also an important issue for economics, economic analyses of organized crime are still scarce, as noted by Fiorentini and Peltzman (1995). However, there exist some important studies on organized crime. Almost all previous papers have stressed welfare comparisons between monopolistic criminal markets (with a criminal organization) and competitive criminal markets (without a criminal organization) because a criminal organization is considered a monopolistic firm; e.g., Schelling (1967), Buchanan (1973), Gambetta and Reuter (1995) and Garoupa (2000)[1]. According to such a monopolistic view, a monopolistic criminal market is more desirable than a competitive criminal market because the social bads, such as criminal activities, supplied by a criminal organization become smaller.

However, is such a monopolistic view of a criminal organization true? In reality, we often observe miserable conflicts among criminal organizations as in Japan, Italy and other countries. Considering the actual state of affairs, focusing only on monopolistic markets provides limited meaningful implications. Additionally, Fiorentini (1995) argues that there is no convincing reason to support the monopolistic view of illegal markets. Therefore, by extending the analysis to oligopolistic criminal organizations, this paper tries to provide important and novel insight into deterrence policies against them. Furthermore, we aim to examine whether oligopolistic criminal organizations are beneficial in terms of social welfare and efficiency.

Motivated by these observations, in contrast to the monopolistic view, we examine an oligopolistic criminal market that is controlled by oligopolistic criminal organizations and their effects on the optimal law enforcement policy adopted by the government. We extend the optimal law enforcement model with a monopolistic criminal organization, as originally proposed by Garoupa (2000), to incorporate oligopolistic criminal organizations. Following Garoupa, the role of criminal organizations is to regulate the criminal market by extortion. This means that potential offenders must buy a license from the organization to commit an illegal act[2].

[1] Dick (1995) does not stress the monopolistic aspect but alternatively employs a transaction costs approach. Grossman (1995) considers a criminal organization to be a competitor of the state and an alternative provider of public goods rather than a monopolistic firm.

[2] There exist other papers that extend Garoupa (2000) in different directions. One of them is that by Chang et al. (2005), who incorporate the possibility of individual criminals and organized crime coexisting. The role of criminal organization is the same, but potential offenders can choose whether to be a member of a criminal organization. Another paper is that of Garoupa (2007), which focuses on internal organizational aspects between the principal and agents.

Since the main difference between a monopoly and an oligopoly is introducing a strategic interaction, we consider two different types of competition. The first competition is to attract potential offenders to enter the criminal markets. If each criminal organization can differentiate their criminal markets, competition among them may occur. In contrast, if each criminal organization does not need to differentiate, they face no or less competition. Hence, we model these two different competition structures for the first type of competition.

The second competition is to acquire a monopoly by engaging in violent conflicts. As observed in reality, conflicts for market opportunities among criminal organizations occur constantly[3]. An incentive for waging wars is derived by the benefits of obtaining monopoly profits. Thus, if criminal organizations prefer monopoly profits to oligopoly profits, conflicts will be inevitable.

By incorporating these two features, this paper yields novel insights. First, this paper shows that the classical view, which stresses the superiority of a monopolistic criminal organization, does not always apply. Whether the classical view holds depends on the strategic relationships among criminal organizations. If criminal organizations face extremely fierce competition in collecting potential offenders, oligopolistic criminal markets cannot be sustained because criminal organizations cannot obtain profits. As a result, the superiority of introducing criminal organizations that holds in the monopoly case is not achieved because criminal organizations cannot work as regulators in the criminal market. In this case, each criminal organization has an incentive to wage wars to monopolize the criminal market. This indicates that the government must consider the extra cost associated with conflicts; thus, the optimal law enforcement policy may become harsher, and the associated expenditure may increase. This result contrasts that of Garoupa (2000), who find that a criminal organization contributes to less harsh deterrence policies. However, if criminal organizations face mild or no competition, oligopolistic criminal markets will contribute to improved social welfare efficiency. This result is intuitive because there exist more criminal organizations to regulate the criminal market. This result reinforces the superiority of introducing oligopolistic rather than monopolistic criminal organizations. However, even if an oligopolistic criminal market is desirable for society, criminal organizations with strong military power prefer violent conflicts. This might cause social welfare losses, as discussed in the above case, and an oligopolistic market could not be sustained.

Second, this paper models violence and its effects in an explicit manner. For this framework, we can obtain the analytical strength of the interaction between the incentive to wage wars and the enforcement of the law. It is unclear whether the imposition of harsh penalties by the government causes more conflicts, as noted by Hill (2003) and Dell (2015)[4]. Focusing on the difference of the military

[3]Hill (2004) examines how disputes between Japanese criminal organizations arise and presents some resolutions and difficulties. Additionally, Catanzaro (1994) investigates conflicts among Italian criminal organizations.

[4]Let us introduce two examples about the consequences of harsh penalties against Mafias. Hill (2003, pp. 209) finds that the introduction of the countermeasures law against the Japanese Mafia (Yakuza) in 1992 made the Yakuza attempt to reduce inter-Mafia conflicts. As

power and the effectiveness of the deterrence policy related with the number of Mafias, this paper provides some explanations for this complicated problem and shows that harsher penalties do not always yield conflicts. By considering violent conflicts and law enforcement structures in an explicit manner, we show that a peaceful equilibrium can be achieved, with no trade-off between violence and crime (social bads). As a result, no violence will contribute to low crime, and with the same logic, violence will induce more crime because criminal organizations can work as regulators in the former case but not in the latter.

Other papers focus on the economic effects of oligopolistic criminal organizations in bads markets. Fiorentini (1995) models the market for illegal goods, such as drugs, and considers oligopolistic competition in price and quantity. Fiorentini shows that whether a monopolization contributes to the reduction of social bads depends on the government's strategy, allowing a biased deterrence policy against some organizations. Masour et al. (2006) examines a model in which a group of criminal organizations is endogenous without the use of violence. Kugler et al. (2005) considers the possibility of corruption between the law enforcer and multiple criminal organizations. As explained above, these paper do not consider the process of monopolization or oligopolization.

This paper is organized as follows. Section 2 describes the basic model of the optimal law enforcement policy. In section 2.1, we introduce the benchmark result in the case of no criminal organization, as originally proposed by Garoupa (2000). Section 3 introduces the model developed by Garoupa and considers our extensions. Focusing on the different forms of strategic relations, we derive the optimal strategy that each economic actor should adopt in sections 3.1 and 3.2. In section 4, we add the possibility of engaging in conflicts and the effect of doing so in a duopoly market case. Finally, section 5 concludes.

2 A model without a criminal organization

In this section, we introduce the basic model for the optimal enforcement of the law, which is identical to that of Garoupa (2000). We introduce risk-neutral potential offenders who choose whether to commit an illegal act that benefits the offender by b, which varies across potential offenders, and harms the rest of society by $h > 1$. The government does not know any offenders' b but does know its distribution: b is uniformly distributed over $[0, 1]$. The assumption $h > 1$ means that committing an illegal act is not socially beneficial.

The government chooses a sanction f and a detection and conviction probability p. The expenditure on detection and conviction is $C(p)$, which is an increasing function of p. For simplicity, we assume $C(p) = cp$, where $c > 0$ is a cost parameter. Also, we assume $0 \leq f \leq F$, where F is the maximum feasible sanction, which can be interpreted as the maximum wealth of individuals. The objective function of the government is to maximize the social welfare, the sum

a result, inter-Mafias conflicts decreased. In contrast, according to Dell (2015), the Mexican policy against drug trafficking has caused violence among drug trafficking organizations.

of offenders' benefits minus the sum of the harm caused by them and the enforcement cost. We follow the standard assumption that offenders' benefits are considered for social welfare.

2.1 A competitive criminal market

This subsection introduces the main result proposed by Garoupa (2000). As an important benchmark, we consider a situation with no criminal organization. We call this situation a competitive criminal market because, as mentioned in the introduction, there exists no criminal organization that can regulate entry into this criminal market. Potential offenders commit an illegal act if and only if $b \geq pf$. Thus, the social welfare is

$$W = \int_{pf}^{1} (b - h) db - cp \tag{1}$$

The government maximizes the social welfare W with respect to p and f. Let us use the subscript C to denote the results obtained in a competitive criminal market.

Proposition 1 (Garoupa (2000)). In a competitive criminal market, the optimal fine is the maximum fine ($f = F$). The optimal detection probability is $p^C F = h - c/F$.

3 A model with oligopolistic criminal organizations

In this section, we introduce criminal organizations (the Mafias). The role of a Mafia is to regulate the criminal market by extortion. This means that potential offenders must buy a license from the the Mafia to commit an illegal act. Garoupa (2000) treats criminal organizations as a vertical structure: the Mafia extracts some rents from potential offenders via extortion [5]. This paper aims to extend Garoupa's model to an oligopolistic competition among multiple criminal organizations by incorporating strategic aspects. Formally, there exist n Mafias, and each potential offender must pay e_i to one of the Mafia $i \in \{1, 2, ..., n\}$ to commit an illegal act. The Mafia i tries to maximize profits with respect to e_i.

What is the strategic relationship amongst the Mafias? We introduce different two types of competition: (a) competition for attracting potential offenders and (b) competition for monopolization. An example of type (a) competition is as follows: if Mafia 1 demands an excessive license fee and Mafia w demands no license fee, potential offenders would want to enter the latter criminal market.

[5] This paper considers only costless extortion situations, although Garoupa also considers extortion to be costly.

In this case, as in price competitions such as Bertrand competition, demanding a high price will cause low profit for the Mafia. However, is there always such fierce competition among Mafias? If potential offenders cannot move across districts, severe competition will not arise. Additionally, collecting information about the Mafia may be difficult for potential offenders, and there may be no competition among the Mafias. Therefore, regarding type (a) competition, we consider further different two types of strategic relations amongst the Mafias: (a.1) no competition and (a.2) Bertrand competition.

Regarding type (b) competition, if the Mafias find that the profit in a monopolistic criminal market is greater than that in an oligopolistic criminal market, the Mafias may have an incentive to wage war, even if such a war may be costly. In this case, the government must address the social welfare loss caused by conflicts. Thus, the government should adopt a different strategy. First, we consider only (a.1) and (a.2) competition in sections 3.1 and 3.2. Type (b) competition is considered in section 4.

3.1 A criminal market with oligopolistic criminal organizations: no-competition case

If there exists no competition among the Mafias, the potential offenders would enter the criminal markets controlled by Mafia i with some probability q_i. For simplicity, we assume that $q_i = 1/n$, $\forall i$. Thus, the expected benefit for potential offenders from committing an illegal act is $b - pf - \sum_i^n e_i/n$. Thus, potential offenders enter the criminal market if and only if $b \geq pf + \sum_i^n e_i/n$. Also, the profits of Mafia i are

$$\pi_i = \int_{pf+\sum_i^n e_i/n}^{1} e_i/n db. \tag{2}$$

Following Garoupa (2000), we consider two types of game: (1) a Nash-Cournot game and (2) a Stackelberg game. In (1), the government and the Mafias decide their strategies simultaneously. In (2), the government moves first, and the Mafias move later[6].

Nash-Cournot game. The social welfare function is

$$W = \int_{pf+\sum_i^n e_i/n}^{1} (b-h)db - cp. \tag{3}$$

The government maximizes the social welfare function with respect to p and f subject to $0 \leq f \leq F$. According to the standard maximization problem with the Lagrangian method, the optimal fine is also the maximum fine, as in Proposition 1. Hence, we obtain the government's reaction function against the Mafias' strategies:

[6]Garoupa (2000) provides the various reasons to adopt these two approaches.

$$pF = h - \sum_{i}^{n} e_i/n - c/F. \tag{4}$$

Additionally, according to the standard maximization problem, Mafia i's reaction function against the government strategy is

$$e_i = \{n(1 - pf) - \sum_{j \neq i}^{n} e_j\}/2. \tag{5}$$

Moreover, because all of the Mafia have the same objective function, we assume a symmetric equilibrium; thus, $e_i = e_j, \forall\ i\ and\ j$. In the following analysis, we assume the interior solutions.

Proposition 2. In the no-competition (NC) case with multiple criminal organizations and a Nash-Cournot game situation, the optimal fine is the maximum fine ($f = F$). Given the number of the Mafias, the optimal detection probability is $p^{NC}F = (n + 1)h - n - (n + 1)c/F$. $p^{NC}F$ decreases as n increases.

Proof. As mentioned above, we use the Lagrangian method. Basically, we follow the proof presented in Garoupa (2000). Define the Lagrangian as $L = W + \lambda(F - f)$, where λ is the Lagrange multiplier. The first-order conditions are

$$L_f = p(h - pf - \sum_{i}^{n} e_i/n) - \lambda = 0 \quad and \tag{6}$$

$$L_p = f(h - pf - \sum_{i}^{n} e_i/n) - c = 0. \tag{7}$$

Suppose that the optimal fine, f^*, is not maximal. From (6), we must have $h - p^* f^* - \sum_i^n e_i/n = 0$, where p^* is optimal detection probability. However, this is impossible according to (7). Hence, the optimal sanction f^* must be maximal, $f^* = F$, and $\lambda^* > 0$. Also, $dp^{NC}F/dn = h - 1 - c/F < 0$ because we assume $0 < p^C F = h - c/F < 1$. Q.E.D.

This result indicates that as the number of the Mafias increases, the government reduces its expenditure on law enforcement. Additionally, the equilibrium extortion by the Mafias $e^{NC} = n(1 - h + c/F)$ increases with n. This means that each Mafia tries more extortion because of rivalry among the Mafias; as a result, it is difficult for offenders to enter the market. The intuition underlying this proposition is straightforward. Because the government and Mafias play the same role in criminal market, the government tries to avoid the cost of detecting criminals when more Mafias exist. As a result, the government adopts a weaker deterrence policy when more Mafias exist.

Note that in the case of $n = 0$, $p^{NC}F = h - c/F = p^C$, and in the case of $n = 1$, $p^{NC}F = 2h - 1 - 2c/F$. In particular, the latter results correspond to the monopolistic criminal market proposed in Garoupa (2000). From a theoretical view point, this result can be interpreted as the generalization of the optimal law enforcement model with organized crime originally proposed by Garoupa.

Additionally, the equilibrium criminal rate and the equilibrium profits for the Mafias do not depend on n. What effects does the presence of multiple criminal organizations have on social welfare? The answer is summarized as follows:

Corollary 1. In the NC case with multiple criminal organizations and a Nash-Cournot game, the equilibrium social welfare is $W^{C}_{n=0} < W^{NC}_{n=1} < W^{NC}_{n=2} < \cdots < W^{NC}_{n=n}$.

This means that social welfare will improve as the number of Mafias increases. This result is also derived from the same reason as proposition 2. Hence, as long as Mafias can work as regulators in this criminal market, oligopolistic Mafias can contribute to social welfare efficiency compared to the monopolistic market. Therefore, the classical view about organized crime a monopolistic bads markets is desirable is not supported as long as potential offenders cannot choose markets freely.

Stackelberg game. In the Stackelberg game, the government moves first, and the Mafias moves later. Thus, the first-order conditions for Mafia i's extortion are $e_i = \{n(1-pf) - \sum_{j\neq i}^{n} e_j\}/2$. As in the Nash-Cournot game, we assume a symmetric equilibrium. Thus, the social welfare function is

$$W = \int_{n/(n+1)+pf/(n+1)}^{1} (b-h)db - cp. \tag{8}$$

Therefore, according to the standard optimization problem with the Lagrangian method, we obtain the following results:

Proposition 3. In the NC case with multiple criminal organizations and a Stackelberg game, the optimal fine is the maximum fine ($f = F$). Given the number of the Mafias, the optimal detection probability is $p^{NC}F = (n+1)h - n - (n+1)^2c/F$. $p^{NC}F$ decreases as n increases.

Proof. By the same argument as in the proof of Proposition 2, define the Lagrangian as $L = W + \lambda(F - f)$ where λ is the Lagrange multiplier. The first-order conditions are

$$L_f = p(h - pf - n/(n+1) + pf/(n+1)) - \lambda = 0 \quad and \tag{9}$$

$$L_p = f(h - pf - n/(n+1) + pf/(n+1)) - c = 0. \tag{10}$$

Suppose that the optimal fine, f^*, is not maximal. From (9), we must have $h - p^*f^* - n/(n+1) + pf/(n+1) = 0$, where p^* is optimal detection probability.

However, this is impossible according to (10). Hence, the optimal sanction f^* must be maximal, $f^* = F$, and $\lambda^* > 0$. $p^{NC}F$ decreases as n increases, as in the proof in Proposition 2. Q.E.D.

As in Proposition 2, as the number of Mafias increases, the expected punishment $p^{NC}F$ decreases. The main difference between the Nash and Stackelberg games is that extortion will be high in the Stackelberg game and the equilibrium crime rate will decrease as the number of the Mafias increases. As a result, the social welfare will also increase as the number of criminal organizations increases.

Corollary 2. In the NC case with multiple criminal organizations and a Stackelberg game, the equilibrium social welfare is $W^C_{n=0} < W^{NC}_{n=1} < W^{NC}_{n=2} < \cdots < W^{NC}_{n=n}$.

This corollary holds because in equilibrium, the marginal effect of an increase in the number of criminal organizations on social welfare is

$$\partial W^{NC}/\partial n = nc/F - (h - 1 - c/F) > 0. \tag{11}$$

3.2 A criminal market with oligopolistic criminal organizations: Bertrand competition case

If the competition among the Mafias is a Bertrand price competition, potential offenders would enter the criminal market that yields the highest expected benefits. Therefore, potential offenders enter the criminal market controlled by Mafia $i \in \{1, 2, ..., n\}$ if and only if $b - pf - e_i > b - pf - e_j$ for $j \neq i$. In other words, criminal market i is preferred over any other criminal market if and only if $e_j > e_i$. This condition is very intuitive. In the same manner, we can define the profits for Mafia i as

$$\pi_i = \begin{cases} \int_{pf+e_i}^{1} e_i db & if \;\; e_j > e_i \; \forall j \neq i \\ \int_{pf+e_i}^{1} e_i db/M & if \;\; e_j = e_i \; with \; |j| = M-1, and \; e_k > e_i \; for \; other \; k \\ 0 & if \;\; e_j < e_i \; \forall j \neq i. \end{cases} \tag{12}$$

In this Bertrand competition case, the Nash equilibrium is $e_i^* = 0, \forall\, i$, and $\pi_i^* = 0, \forall\, i$, in the Cournot and Stackelberg games, respectively. As a result, potential offenders join criminal market i if and only if $b \geq pf$. This result means that the profit for the Mafias becomes 0 and that there exists no regulation of criminal markets. Therefore, we have the same results as in Proposition 1.

Proposition 4. In the Bertrand competition (BC) case with multiple criminal organizations, the optimal fine is the maximum fine ($f = F$). The optimal detection probability is $p^{BC}F = h - c/F$. These results are the same as those found in a competitive criminal market.

This proposition implies that as long as the Mafias face fierce competition, such as Bertrand price competition, introducing Mafias will not contribute to improved social welfare compared with a competitive criminal market case. Therefore, the social welfare-improving effects of the Mafia in Garoupa (2000) do not apply in oligopolistic criminal markets. Furthermore, the classical view about organized crime that monopolistic bads markets are superior is supported as long as potential offenders can choose markets easily.

We now remark about some extensions. Let us assume that each Mafia can provide an offender with an advantage in committing a crime. That is, the probability of apprehension and conviction varies across the criminal market controlled by the Mafia i. We assume that $p_i = p(p, \theta_i)$ is a function of p and the parameter θ_i, which specifies the apprehension probability associated with each of the Mafias and is strictly less than the apprehension probability in a competitive criminal market, $p_i < p$. This is because the Mafias can provide some information to offenders[7]. Thus, if we introduce a heterogeneous apprehension probability, the optimal strategy that the government should employ will be altered.

Motivated by the above extension, we derive additional results. Potential offenders enter criminal market $i \in \{1, 2, ..., n\}$ if and only if $b - p_i f - e_i > max_{j \neq i} b - p_j f - e_j$.Without loss of generality, we assume $p_1 < p_2 < ... < p_n$, given the value of p. Entering criminal markets controlled by Mafia 1 is beneficial for potential offenders as long as every Mafia demands the same license fee. In this case, Mafia 1 will use its advantage to gain profits, so a zero-profit equilibrium does not occur, as in Proposition 4. In this case, the equilibrium extortion is $e_1^* = (p_2 - p_1)f - \epsilon$, and $e_j^* = 0 \; \forall j \neq 1$, where ϵ is small enough [8]. As a result, the Mafia 1 can obtain a monopoly in this criminal market. Regarding the government strategy, the government maximize the new social welfare $W = \int_{p_2 f + \epsilon}^{1} (b - h) db - cp$. This means that the government's strategy becomes less effective, so it may invest less in detection. As a result, the equilibrium crime rate will increase, and it is unclear whether the social welfare will improve.

[7] Garoupa (2007) examines this problem more deeply.

[8] If $e_j > 0$ for some $j \neq 1$, a potential offender's expected benefits in criminal markets 1 and $j \neq 1$ are $b - p_1 f - (p_2 - p_1) f + \epsilon$ and $b - p_j f - e_j$, respectively. Hence, Mafia 1 can collect all offenders if and only if $\epsilon + e_j + (p_j - p_2) f > 0$. This condition is always satisfied, and Mafia j's profit is zero. In contrast, if $e_j^* = 0$ for all $j \neq 1$, for Mafia 1 to obtain profits, Mafia 1 sets e_1 such that $b - p_1 f - e_1 > max_{j \neq i} b - p_j f$. Hence, e_1 mast satisfy $(p_j - p_1) f > e_1$ for all $j \neq 1$. Hence, we must have $e_1^* = (p_2 - p_1) f - \epsilon$.

4 An extension : the possibility of violent conflicts

In this section, we extend the basic model introduced in section 3 to incorporate the possibility of conflicts amongst the Mafias. One of the main differences between the legal and illegal goods markets is the use of violence. In the illegal goods market, Mafias often resort to violence to exclude other Mafias from the market and monopolize rent extraction.

What is the optimal law enforcement policy for the government in a criminal market with multiple criminal organizations in case of the possibility costly conflict? What is the relation between the deterrence policy and the incentive for the Mafias to engage in violent conflict? To answer these questions, we integrate the simple conflict theory, i.e., Garfinkel and Skaperdas (2007) and Konrad (2009), into our basic model.

For simplicity, we assume that there exist two Mafias, Mafia 1 and 2. Thus, our setting is a duopolistic criminal market case. The game proceeds as follows. At first, the government announces the detection probability, p, and the sanction, f. After observing the government strategy, Mafias 1 and 2 decide whether to wage a war. If there exists no violent conflict, the duopoly profits are realized. If there exists a violent conflict, the winner obtains the monopoly profits, and the loser receives no profits. Thus, this setting is an extension of the Stackelberg game situation.

According to our results, the monopolistic profits will be $\pi^M = ((1-pf)/2)^2$. The duopolistic profits in the Bertrand competition case (Duopolistic Bertrand Competition) are $\pi^{DBC} = 0$, and those in the NC case (Duopolistic No Competition) are $\pi^{DNC} = ((1-pf)/3)^2$. Based on the basic conflict theory proposed by Tullock (1980), we define the expected profits from engaging in conflict. In case of conflicts, Mafias 1 and 2 can invest military resources g_1 and g_2 to win conflicts. The probability of winning for each Mafia depends on the ratio of the amount of invested resources. Let p_i be the probability of Mafia i winning; thus, we have $p_1 = \beta g_1/(\beta g_1 + g_2)$ and $p_2 = g_2/(\beta g_1 + g_2)$, where $\beta \geq 1$. The value β represents the relative ability of Mafia 1 in terms of effectiveness of investments, and we assume that the value is exogenously given. This setting means that if every Mafia invests the same amount of resources, the probability of Mafia 1 winning is greater than that of Mafia 2 winning. Therefore, the expected profits for Mafias 1 and 2 are

$$\pi_1^V = \{\beta g_1/(\beta g_1 + g_2)\}\pi^M - g_1 \textit{ and } \pi_2^V = \{g_2/(\beta g_1 + g_2)\}\pi^M - g_2. \qquad (13)$$

The subscript V represents the situation in a conflict and war. Thus, from the standard optimization problem, we obtain the first-order conditions for each Mafia:

$$d\pi_1^V/g_1 = \{\beta g_2/(\beta g_1 + g_2)^2\}\pi^M - 1 = 0 \textit{ and} \qquad (14)$$

$$d\pi_2^V/dg_2 = \{\beta g_1(\beta g_1 + g_2)^2\}\pi^M - 1 = 0. \tag{15}$$

Therefore, we obtain Lemme 1.

Lemma 1. The equilibrium invested resources for Mafias 1 and 2 are $g_1^* = g_2^* = \beta/(1+\beta)^2\pi^M$. The equilibrium expected profits for Mafias 1 and 2 are $\pi_1^V = (\beta/(1+\beta))^2\pi^M$ and $\pi_2^V = (1/(1+\beta))^2\pi^M$.

According to a simple calculation, we can see that differences in military power and violence will make it difficult to avoid violent conflicts. Hence, in the case of Bertrand competition, it is always true that $\pi_1^V > \pi_1^{DBC} = 0$, according to the discussion in section 3.2. Thus, the Mafia has an incentive to avoid a Bertrand competition and to try to monopolize the criminal market. Additionally, in the case of no competition, if $\beta > (\leq) 2$, $\pi_1^V > (\leq)\pi_1^{DNC}$. This indicates that as long as Mafia 1 has an advantage in conflict, Mafia 1 would prefer to wage a war. As a result, the social welfare function becomes different from the previous one. Let us use $r > 1$ to denote the harm caused in the process conflicts[9]. At first, we examine the NC case; the social welfare function is summarized below.

$$W^{DNC} = \begin{cases} \int_{1/2+pf/2}^{1}(b-h)db - (g_1^* + g_2^*)r - cp & if \quad \beta > 2 \\ \int_{2/3+pf/3}^{1}(b-h)db - cp & if \quad \beta \leq 2. \end{cases} \tag{16}$$

In the case of $\beta > 2$, the new social welfare function corresponds to the monopolistic criminal market and contains the social welfare loss caused by conflicts. Conversely, in the case of $\beta \leq 2$, the new social welfare function corresponds to the duopolistic criminal market without conflict. Therefore, we obtain the optimal government strategy.

Proposition 5. In the NC case with the possibility of conflict, the optimal fine is the maximum fine ($f = F$). The optimal detection probability is $p^V F = \{2h - 1 - 4c/F + (4\beta r)/(1+\beta)^2\}/\{1 + (4\beta r)/(1+\beta)^2\}$ if $\beta > 2$ and $p^V F = 3h - 2 - 9c/F$ if $\beta \leq 2$.

Proof. By the same argument as in the proof of Proposition 2, define the Lagrangian as $L = W + \lambda(F - f)$, where λ is the Lagrange multiplier. In the case of $\beta > 2$, the first-order conditions are

$$L_f = p(h/2 - 1/4 - \beta r/(1+\beta)^2 - pf/4 - pf\beta r/(1+\beta)^2) - \lambda = 0 \quad and \tag{17}$$

$$L_p = f(h/2 - 1/4 - \beta r/(1+\beta)^2 - pf/4 - pf\beta r/(1+\beta)^2) - c = 0. \tag{18}$$

[9] In the case of $r = 1$, the society suffers from only dissipation, i.e., Nitzan (1991). However, in the case of $r > 1$, the society suffers from not only dissipation but also harms related to conflicts.

Suppose that the optimal fine, f^*, is not maximal. From (16), we must have $(h/2-1/4-\beta r/(1+\beta)^2-p^*f^*/4-pf\beta r/(1+\beta)^2)=0$, where p^* is the optimal detection probability. However, this is impossible according to (17). Hence, the optimal sanction f^* must be maximal, $f^*=F$, and $\lambda^*>0$. In case of $\beta\leq 2$, the proof follows as in Proposition 3. Q.E.D.

Additionally, we can derive the optimal strategy in the case of a Bertrand competition with a duopolistic Mafia.

Corollary. In the case of a Bertrand competition with the possibility of conflict, the optimal fine is the maximum fine ($f=F$). The optimal detection probability is $p^VF=\{2h-1-4c/F+(4\beta r)/(1+\beta)^2\}/\{1+(4\beta r)/(1+\beta)^2\}$.

These results indicate that if we consider the possibility of conflict, the expected punishment in a competitive and monopolistic criminal market, p^CF and p^MF, may be less than p^VF as long as r is large. This means that introducing Mafias does not always lead to reduced law enforcement expenditures, which contrasts the results of Garoupa (2000). In this case, tougher penalties as a response to violent conflict can be supported, as observed in reality. Even if the duopoly criminal market is desirable, it cannot be sustained because of difficulty avoiding conflict.

Let us remark about the value β and its effect. What is the equilibrium if each Mafia can choose its effectiveness in conflicts? Let $\beta_H>2$ and $\beta_L=1$ be the two values that the Mafia can choose. The Mafia has to pay s in obtaining β_H and nothing in β_L. Each Mafia can choose either β_H or β_L before deciding to engage in conflicts. Choosing β_H is optimal for Mafias 1 and 2 if the cost parameter s is low. This means that if the Mafia can obtain weapons for conflicts with low cost, the optimal strategy for the Mafias is no conflict, and their equilibrium payoff decreases. This outcome is similar to the Prisoner's Dilemma. This implicates that if the government does not regulate the weapons the Mafias use, the low Mafia profit can be achieved, and no conflict will exist. Hence, to achieve low profits for the Mafias, less regulations on weapons can be optimal. However, in reality, because the government tries to regulate weapons, the cost parameter s is high. As a result, no conflict equilibrium can be achieved, but the equilibrium profits for the Mafia become high.

4.1 The heterogeneity of the detection probability between duopoly and monopoly

In this subsection, we consider the heterogeneity of the detection and conviction probability. We assume that the detection and conviction probability in a duopolistic market can be different from that in a monopolistic market. If there exists such heterogeneity, the incentive to engage in conflicts can differ. This assumption is important in the following discussion. In other theoretical papers of the illegal drug market, such as Mansour et al. (2006) and Poret and

Tejedo (2006), agents of Mafias are less likely to be captured in an oligopolistic market compared to a monopolistic one because the government must allocate limited enforcement resources to each Mafia. However, it is not always true that law enforcement in an oligopolistic criminal market is attractive for Mafias because Mafias would engage in unfavorable behavior against rival Mafias. For example, each Mafia can transmit information about rival Mafias to the government. Moreover, in drug trafficking cases, when choosing which route to employ to transport drugs, Mafias must consider rival Mafias' choices. Then, monopolizing the transport routes may be beneficial for Mafias; see Dell (2015) for a more detailed network approach analysis. Although we do not incorporate these strategic aspects in an explicit manner, we assume the possibility that law enforcement against a monopolistic Mafia is less efficient than the oligopolistic situation.

Hence, let $p^M = p^M(p)$ and $p^D = p^D(p)$ be the detection probability function in monopolistic and duopolistic criminal markets, respectively; p^M can be less or greater than p^D. Therefore, the expected profits become $\pi_1^V = (\beta/(1+\beta))^2\pi^M$ and $\pi_2^V = (1/(1+\beta))^2\pi^M$. Also, $\pi^{DNC} = ((1-p^D f)/3)^2$ in the NC case. Focusing on the NC case, we examine the incentive for Mafia 1. Additionally, for simplicity, we assume that the difference in the detection probability between the duopolistic and monopolistic markets is represented by $0 < \theta < 1$, that is, $p^M = \theta p < p = p^D$ or $p^D = \theta p < p = p^M$. Therefore, Mafia 1 has an incentive to engage in violent conflict if $\pi_1^V = (\beta/(1+\beta))^2\pi^M = (\beta/(1+\beta))^2((1-p^M f)/2)^2 > ((1-p^D f)/3)^2 = \pi^{DNC}$. Moreover, to consider the relationship between the incentive to engage in violent conflict and the government's punishment strategy, we treat the law enforcement pf as given. In addition, we define $b^M = 1/2 + p^M f/2$ and $b^D = 2/3 + p^D f/3$. Since the values of b^M and b^D represent the effect of Mafias as regulators of criminal markets, we can investigate whether Mafias have deterrence effects for individual criminals.

First, we consider the case of $p^D = \theta p < p = p^M$. According to a simple calculation, if the value of β is high and $(\beta' - 1)/(\beta' - \theta) > pf$, where $\beta' = 3\beta/(2(1+\beta))$, we have $\pi_1^V > \pi^{DNC}$. [10]. This means that if Mafia 1 has an advantage in violent conflicts and a duopoly is attractive for individual criminals, low punishment will induce violent conflict[11]. Moreover, if $1/(3-2\theta) > pf, b^D > b^M$. Hence, when harsh penalties $pf \in ((\beta'-1)/(\beta'-\theta), 1/(3-2\theta))$ are possible, no violence and low crime can be achieved [12]. This result indicates that a severe stance against Mafias can be supported.

Second, we consider the case of $p^M = \theta p < p = p^D$. According to a simple calculation, if the value of β is low and $pf > (1-\beta')/(1-\beta'\theta)$, where $\beta' = 3\beta/(2(1+\beta)), \pi_1^V > \pi^{DNC}$ [13]. This means that if Mafias 1 and 2 have no comparative advantage in violent conflicts and if a monopoly is at-

[10] If β is low, Mafia 1 has no incentive to engage in violent conflict

[11] The new social welfare function will be $W = \int_{1/2+p^M f/2}^{1}(b-h)db - (g_1^* + g_2^*)r - cp$ if $pf < (\beta'-1)/(\beta'-\theta)$ and $W = \int_{2/3+p^D f/3}^{1}(b-h)db - cp$ if $pf > (\beta'-1)/(\beta'-\theta)$.

[12] Additionally, we assume that $pf < 1/\theta$.

[13] If β is high, Mafia 1 always has an incentive for violent conflict.

tractive for individual criminals, harsh punishment will induce violent conflict[14]. Moreover, if $1/(3\theta-2) > pf$, $b^D > b^M$. Hence, when harsh penalties $pf \in ((1-\beta')/(1-\beta'\theta), 1/(3\theta-2))$ are possible, the use of violence and high crime caused by harsh penalties are inevitable because Mafias cannot work as regulators of the criminal market. This result indicates that severe stances against Mafias cannot be supported.

The main results with and without the trade-off between violence and crime are summarized below:

Proposition 6. (1) If the value of β is high and $p^D = \theta p < p = p^M$, when penalties $pf \in ((\beta'-1)/(\beta'-\theta), 1/(3-2\theta))$ are possible, no violence and low crime can be achieved ($\pi^{DNC} > \pi_1^V$ and $b^D > b^M$). (2) If if the value of β is low and $p^M = \theta p < p = p^D$, when penalties $pf \in ((1-\beta')/(1-\beta'\theta), 1/(3\theta-2))$ are possible, the use of violence and high crime caused by harsh penalties are inevitable ($\pi_1^V > \pi^{DNC}$ and $b^D > b^M$).

The intuition of this proposition is as follows. For (1), in case of low expected penalties, strong Mafias prefer monopoly profits with violent conflicts; however, in the case of high expected penalties, because the difference in profits between monopoly and duopoly becomes small, strong Mafias hesitate to make costly investments in violent conflict. Regarding (2), even if Mafias do not have an advantage in terms violence, in the case of a high expected punishment, the monopoly profit is attractive because $p^M < p^D$. However, in the low-punishment case, since the difference in detection probability is small, the duopoly profits are attractive.

Finally, let us introduce interesting Japanese examples that can be explained by this paper's result. According to (1) in proposition 6, if $pf > max\{(\beta'-1)/(\beta'-\theta), 1/(3-2\theta)\}$, we have fewer inter-Mafia conflicts and high crime, $\pi^{DNC} > \pi_1^V$ and $b^M > b^D$. This result is consistent with the Japanese examples. At first, there existed one strong and predominant Japanese Mafia (Yakuza) in one region. Thus, this predominant Mafia tended to have strong military power compared to other weak Mafias. Moreover, since the government and public law enforcer must allocate resources to each Mafia, our assumption $p^D = \theta p < p = p^M$ is reasonable. According to Hill (2003, pp. 209), the introduction of a countermeasures law against Japanese Mafias (Yakuza) in 1992 resulted in a reduction in inter-Mafia conflicts[15]. However, simultaneously, Hill noted that the crime rate increased because Japanese Mafias lost their power as regulators in the criminal market. Hill's assertion can be supported by this paper's results. By our analysis, because of the strategic relationships between the government and Mafias, harsh penalties imposed by the government make Mafias have lower

[14] The new social welfare function will be $W = \int_{2/3+p^D f/3}^{1}(b-h)db - cp$ if $pf < (1-\beta')/(1-\beta'\theta)$ and $W = \int_{1/2+p^M f/2}^{1}(b-h)db - (g_1^* + g_2^*)r - cp$ if $pf > (1-\beta')/(1-\beta'\theta)$.

[15] In Hill (2003), the average number of inter-Mafia conflicts in the 1990s was less than one-third that in the 1980s.

incentives to extract money from individual criminals.

5 Concluding remarks

This paper develops a model for the optimal law enforcement policy in the presence of organized crime by extending the model originally proposed by Garoupa (2000) to oligopolistic criminal organizations, i.e., Mafias. The role of the Mafias is to regulate the criminal market by extortion. Based on this framework, we can examine the interaction among criminal organizations and the government and determine its effect, which has not been addressed in the previous literature. This paper asks the following question: will oligopolistic Mafias contribute to the improvement of social welfare?

This paper considers two types of structures of competition among criminal organizations. The first one is that criminal organizations face fierce competition when collecting potential offenders (agents) in criminal markets to obtain profits. The second one is that there exists no such a competition. If criminal organizations suffer from severe competition, introducing criminal organizations cannot lead to improved social welfare. However, if there is no competition among organizations, an oligopolistic criminal market will contribute to social welfare improvement because of the existence of more regulators in the criminal market. Hence, this paper shows that whether competition among criminal organizations contributes to social welfare improvement depends on the structure of the strategic relations amongst the organizations. These results differ from the previous literature, which stresses the desirability of monopolistic criminal organizations; see, e.g., Buchanan (1973), Schelling (1967) and Garoupa (2000). In other words, a criminal market controlled by one monopolistic Mafia is not always preferable.

In addition to a competition for collecting agents, this paper considers the possibility of violent conflict. By considering the social welfare loss caused by violent conflict, the government has to change its optimal strategy. Additionally, we can obtain new insight into the incentive to engage in conflict because it is unclear whether harsher penalties cause increased violent conflict among Mafias. We show that whether the government adopting harsh penalties induces violent conflicts depends on the comparative advantage of violence and the effectiveness of deterrence policies, which are both related to the number of Mafias. By considering these aspects, harsh penalties against criminal market may or may not induce violent conflict. As a result, more or less crime will be committed, depending on whether Mafias can or cannot play the role of regulators in the criminal market. Hence, the government has to consider the incentive of Mafias to engage in violent conflicts and its related cost. In other words, it is not always true that Mafias contribute to less severe punishment and reduced expenditure, as claimed in the previous literature. Our results can provide sufficient explanations for the behavior of Japanese Mafias (Yakuza), for example.

This paper's model raises some points to be considered in future analyses.

First, this paper considers only two different extreme competition situations. However, actual competition among criminal organizations lies between these extreme cases. Hence, a more general model should be developed. Second, we should consider the possibility of collusion among the Mafias. If the government sets harsh penalties, waging wars is not the only option for the Mafias; instead, they may engage in cooperative activities against the government.

References

Becker, G.S., (1968). Crime and Punishment: An Economic Approach. *The Journal of Political Economy*, 76(2), 169-217.

Buchanan, J.M., (1973). A Defense of Organized Crime? , In: Rottenberg, S. (Eds.), *The Economics of Crime and Punishment*. Washington, DC: American Enterprise Institute for Public Policy Research, 119-132.

Catanzaro, R., (1994). Violent Social Regulation: Organized Crime in the Italian South. *Social and Legal Studies*, 3(2), 267-81.

Chang, J. J., Lu, H. C. and Chen, M., (2005). Organized Crime or Individual Crime? Endogenous Size of a Criminal Organization and the Optimal Law Enforcement. *Economic Inquiry*, 43(3), 661-675.

Dell, M., (2015). Trafficking Networks and the Mexican Drug War. *The American Economic Review*, 105(6), 1738-1779.

Dick, A. R.,(1995). When Does Organized Crime Pay? A Transaction Cost Analysis. *International Review of Law and Economics*, 15(1), 25-45.

Fiorentini, G. and Peltzman, S., (1995) Introduction. , In: Fiorentini, G. and Peltzman, S. (Eds.),*The Economics of Organised Crime*. Cambridge :Cambridge University Press, 1-30.

Fiorentini, G.,(1995). Oligopolistic Competition in Illegal Markets., In: Fiorentini, G. and Peltzman, S. (Eds),*The Economics of Organised Crime*. Cambridge :Cambridge University Press, 274-292.

Gambetta, D.,(1993) . *The Sicilian Mafia : The Business of Private Protection.* Cambridge, Mass: Harvard University Press.

Gambetta, D. and Reuter, P.,(1995) . Conspiracy Among the Many: The Mafia in Legitimate Industries. In: Fiorentini, G. and Peltzman, S. (Eds.),*The Economics of Organised Crime*. Cambridge :Cambridge University Press, 99-120.

Garfinkel, M. R. and Skaperdas, S., (2007). Economics of Conflict: An Overview., In: Sandler, T. and Hartley, K. (Eds.), *Handbook of Defense Economics: Defense in a Globalized World (Vol. 2).* Amsterdam: Elsevier, 649-709.

Garoupa, N., (1997). The Theory of Optimal Law Enforcement. *Journal of Economic Surveys*, 11(3), 267-295.

Garoupa, N.,(2000). The Economics of Organized Crime and Optimal Law Enforcement. *Economic Inquiry*, 38(2), 278-288.

Garoupa, N. ,(2007). Optimal Law Enforcement and Criminal Organization. *Journal of Economic Behavior and Organization*, 63(3), 461-474.

Grossman, H.I.,(1995). Rival Kleptocrats: The Mafia Versus the State., In: Fiorentini, G. and Peltzman, S. (Eds.),*The Economics of Organised Crime*. Cambridge :Cambridge University Press, 143-156.

Hill, P., (2003). *The Japanese Mafia: Yakuza, Law, and the State*. New York: Oxford University Press.

Hill, P., (2004). The Changing Face of the Yakuza. *Global Crime*, 6(1), 97-116.

Konrad, K. A., (2009). *Strategy and Dynamics in Contest*. Oxford: Oxford University Press.

Kugler, M., Verdier, T. and Zenou, Y., (2005). Organized Crime, Corruption and Punishment. *Journal of Public Economics*, 89(9), 1639-1663.

Mansour, A., Marceau, N. and Mongrain, S., (2006). Gangs and Crime Deterrence. *Journal of Law, Economics, and Organization*, 22(2), 315-339.

Polinsky, A.M. and Shavell, S. (2000). The Economic Theory of Public Enforcement of Law. *Journal of Economic Literature*, 38(1), 45-76.

Poret, S., and Tejedo, C.,(2006). Law enforcement and concentration in illicit drug markets. *European Journal of Political Economy*, 22(1), 99-114.

Schelling, T. C., (1967). Economics and the Criminal Enterprise. *Public Interest*, 7, 61-78.

Skaperdas, S.,(2001). The Political Economy of Organized Crime: Providing Protection When the State Does Not. *Economics of Governance*, 2(3), 173-202.

Skaperdas, S. and Syropoulos, C.,(1995). Gangs as Primitive States., In: Fiorentini, G. and Peltzman, S. (Eds.),*The Economics of Organised Crime*. Cambridge :Cambridge University Press, 61-82.

Tullock, G. (1980). Efficient Rent Seeking., In: Buchanan, J. M., Tollison, R. D. and Tullock, G.(Eds.), *Toward a Theory of the Rent-seeking Society*. College Station, TX: Texas A and M University Press, 97-112.