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ORIGINAL PAPER

Strategic crackdown on organized crime by local governments

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Abstract
This study examines strategic crackdown policies on organized crime between states or nations. In particular, we consider how organized crimes in different regions can affect optimal sanctions for local governments, which face the problem of coordination failure. We demonstrate how the strategic relation between organized crime groups (i.e., complementarity or substitution) affects the strategic relationship between local governments with respect to crackdowns on organized crime. We also demonstrate that if organized crime groups' activities complement each other, the equilibrium sanction level without coordination is lower than the first-best sanction level with coordination and that if organized crime groups' activities substitute each other, the equilibrium sanction level without coordination is higher than the first-best sanction level with coordination.

Keywords Organized crime · Terrorism · Drug trafficking · Mafia · Complementarity · Substitution · Sanction

1 Introduction

Organized crime has recently caused a dire hazard in numerous countries, developed or developing; organized crime has become more severe under social crises, such as the COVID-19 pandemic. *Global Organized Crime Index 2021* defines *organized*

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crime as "illegal activities, conducted by groups or networks acting in concert, by engaging in violence, corruption or related activities to obtain, directly or indirectly, a financial or material benefit" (page 23).[1] Agents in question are criminal organizations, such as mafias, drug cartels, gangs, mobs, and syndicates, terrorist groups that engage in a variety of harmful activities, (e.g., selling and trafficking illegal drugs, migrant smuggling, human trafficking, firearms trafficking, illegal gambling, and extortion using violence). Authorities, such as police organizations and governments, attempt to eradicate these detrimental activities by employing law enforcement strategies.

Considering that an increasing number of criminal organizations extend their activities globally, each local law enforcement authority has to address transnational organized crimes by cooperating. Therefore, we must be attentive to two elements. The first is an interaction/strategic relation among organized crime groups. Given that, two classes of relations can be distinguished. The first type is the rivalry and competitive relations among organized crime groups. For instance, consider two organized crime groups that independently fight for territory or provide illegal goods and services to increase their own illegal profit and decrease other organized crime groups' profits. We label this class "substitution." For example, we can expect rivalry among mafia-type criminal organizations in Italy, such as between Cosa Nostra and 'Ndrangheta and Camorra (Paoli 2014). Additionally, Mexican drug cartels have conflicts with each other regarding the control of drug production and trafficking routes. The second type is the collaborative and cooperative relations among organized crime groups, where one group's activity may increase not only its own profits but also other groups' profits. This can be labeled a "complementary" relation, which tends to hold if each organized crime group is a subgroup of a common mafia family and each clan's action can enhance the reputation of the mafia family and acquire more illegal profits. For example, the above Italian mafia-type criminal organizations, such as Cosa Nostra and 'Ndrangheta and Camorra, are confederations of subgroups and clans; thus, cooperation among subgroups that belong to the same mafia family is likely to occur. Therefore, each clan has the incentive to help other clans in the same mafia family. Additionally, cooperative relations among criminal organizations can be found in the collaboration between local gangs and established organized crime groups (e.g., Sicilian Mafia members and Nigerian gangs (Gaffy 2017), Mexican drug cartels and American street gangs (Schmidt 2012), Japanese Mafia ("Yakuza"), and other emerging loosely organized crime groups (Schreiber 2012)). Therefore, their "complementary" and "substitution" relations can vary based on activities and situations. Furthermore, one organized crime group can acquire skills, knowledge, and information from another to have effective criminal activities, which is well observed in criminal networks.

This interaction between organized crime groups is not the only type of strategic relation. As the second element, we consider an interaction among law enforcement authorities. Organized crime groups in Italy, such as Cosa Nostra and 'Ndrangheta and Cammora, engage in illegal business in their home region and outside. This

[1] Global Initiative Against Transnational Organized Crime (2021).

interregional nature is commonly observed in many organized crime groups. Moreover, different clans in one mafia can be targeted by different local law enforcement authorities, thus, creating a coordination problem for local governments. This is almost inevitable because the local government does not have considerable discretion beyond its territories. For example 'Ndrangheta exercises worldwide influence despite its origination in Calabria in Italy. Therefore, to eradicate their activities, approaches are currently being employed by international law enforcement.[2]

By incorporating the aforementioned two elements, we provide a formal framework to consider interactions among the local organized crime groups and local law enforcement authorities. Specifically, we introduce two local organized crime groups (clans or different mafias) and two local law enforcers (governments). Each local organized crime group engages in harmful activities, such as providing illegal goods and services and using violence to make illegal profits; each local group's activities cause a negative externality in its local region. In response, each local government employs its law enforcement strategies against only the local organized crime group to reduce the negative external effects. Furthermore, we consider that each local organized crime group's actions affect the other organized crime group's profit. The groups' activities are complementary if each organized crime group's activity provides a positive externality for the other group. However, their activities are substitutes if each group's activity provides a negative externality for other groups. Thus, both cases are possible depending on the context.

This study demonstrates that each local government's behavior causes inefficient law enforcement policies. Notably, sanctions can be either overly stringent or lax. Under organized crime groups' complementarity, the equilibrium sanction level without coordination is lower than the first-best sanction level with coordination. In this case, one organized crime group with a complementarity relation has an incentive to reduce illegal activities as another organized crime group decreases its activities. Therefore, one local government's law enforcement decreases its local organized crime group's activities and another local organized crime group's activities, which indicates the positive externality effects of law enforcement. Thus, each local government considering only its region's welfare has the incentive to free-ride to save law enforcement costs and invest fewer resources. This indicates that underenforcement is likely to occur compared to first-best results. Considering that our results can be applied to transnational organized crimes, such as transnational counterterrorism, it is worth mentioning the benefits of the existence of Interpol, which coordinates the member countries' police efforts against common transnational terrorism activities. Notably, Sandler et al. (2011) argue that Interpol resolves the free-rider problems in law enforcement using cost-benefit analysis to evaluate the cost-effectiveness of spending on Interpol counterterrorism measures and demonstrate that transnational terrorist attacks may not induce a larger defense spending response in the presence of coordinated counterterrorism through law enforcement, intelligence, homeland security spending, or the counterterrorism actions of Interpol.

[2] Please see Interpol Cooperation Against 'Ndrangheta (https://www.interpol.int/Crimes/Organized-crime/INTERPOL-Cooperation-Against-Ndrangheta-I-CAN).

Organized crimes are not always complementary. Under substitution conditions, the equilibrium sanction level without coordination is higher than the first-best sanction level with coordination. Thus, one organized crime group with substitution relations has an incentive to increase illegal activities as another group decreases its activities. One local government's law enforcement decreases its local organized crime group's activities but increases another local group's activities, which indicates the negative externality effects of law enforcement. Therefore, each local government considering only its region's welfare has an incentive to invest more resources because of negative spill-over effects in the sense that one local government's enforcement strategies provide detrimental effects to another local region's welfare compared to first-best results. There are several pieces of supporting evidence. Regarding the severe conflict among drug cartels in Mexico, Dell (2015) shows that the violence reflects rival traffickers' attempts to usurp territories after crackdowns have weakened incumbent criminal organizations. Moreover, (Durante and Gutiérrez 2013) use close Mexican elections to argue that coordination across municipalities can reduce drug violence in Mexico. Rios (2015) also indicates that when the same party governs a municipality at every level of government, drug traffickers in Mexico are less likely to cause violent conflict in the presence of an informal connection between the government and drug cartels.

In addition to our main result, which uses the assumption that local governments move simultaneously, we extend this basic setting to consider the sequential choice of enforcement levels between local law enforcers. This extension indicates that the first mover local government has an incentive to establish harsh enforcement to reduce social harm in the region. This result indicates that local governments that battle organized crime groups' activities have an incentive to set severe law enforcement policies to extract more effective enforcement strategies for other regions. Moreover, we briefly consider two additional extensions. One is the case where there is a high-level decision-maker of criminal organizations. The other is the case where the interregional government partly intervenes decisions of local governments.

Our analysis is closely related to two lines of research in law and economics in the literature. First, this study contributes to the economic analysis of criminal organizations.[3] Notably, because (Becker 1968) established an economic analysis of illegal activities by individuals, most previous studies on the economic analysis of criminal organizations have focused on the monopolistic aspects of criminal organizations; see (Schelling 1967; Buchanan 1973; Garoupa 2000, 2007), and Yahagi (2018). However, this study is not the first to consider interactions among oligopolistic criminal organizations. For instance, Mansour et al. (2006) and Poret and Téjédo (2006) discuss how criminal organizations, as producers of illegal goods, endogenize their market structures, and the government's optimal strategy and welfare implications remain uncertain. Moreover, Yahagi (2019) considers how cooperation among criminal organizations emerges, whereas Flores (2016) considers

[3] The economic analysis of illegal activities was originally proposed by Becker (1968), whose focus was not on organized crimes as he only considered the individuals who may commit crimes. See Garoupa (1997) and Polinsky and Shavell (2000) for overviews of the illegal activities of individual criminals.

competition between criminal organizations as a Cournot duopoly game where they produce an illegal good and sabotage each other to gain a larger share of the market using violence. As a novel contribution, we extend these studies' approaches to consider how the regional problems for combatting local criminal organizations caused by the difficulties of local law enforcers coordinating their punishment strategies can be detrimental based on local criminal organizations' relations. Given this study's nature, our arguments share motivation with discussion on counter-terrorism, which has been offered by Arce and Sandler (2005) and Sandler and Siqueira (2006). Particularly, our analysis can be considered as an extension of Sandler and Siqueira's (2006) discussions on counter-terrorism measures to explore how special relations among local criminal organizations affect local governments' crackdown strategies and social welfare.

Second, this study contributes to the literature on the problem of interregional law enforcement. Marceau (1997) models the interrelationship of competing jurisdictions and shows that severe law enforcement in one locality shifts some crime to neighboring communities, which results in excessive enforcement in equilibrium because of the diversion externality. Friehe and Miceli (2016) and Friehe et al. (2018) consider law enforcement in a federal system to address the presence of interregional externalities caused by offenders' location choices and strategic relations among local law enforcement. By extending Marceau (1997), they consider that although detection efforts by local law enforcers cannot be coordinated, the degree of sanctions can be coordinated at the federal level. Considering that these papers do not consider complementarity or substitution among criminal organizations, we provide different implications for law enforcement policies.

The remainder of this paper is organized as follows. Section 2 introduces our basic model. Section 3 provides our results. Section 4 extends our results. Section 5 concludes this paper.

2 Setting

We formulate a game-theoretic model that includes regional organized crime groups and governments. In the following analysis, we use "mafia" to represent an "organized crime group." Of course, our analysis can be applied to a wide variety of organized crime groups such as drug trafficking and terrorist groups. There are two regions ($i = 1, 2$); these regions can be interpreted as states or nations. In each region, there is one group of mafia that engages in illegal activities, such as providing illegal goods and services and engaging in violent activities such as extortion. The activity level of mafia 1 is denoted by x, whereas that of mafia 2 is denoted by y. These are nonnegative real numbers. Each region has its own government that eradicates illegal activities.

Let π^i be the illegal profits from the illegal activities of mafia i. Each π^i depends on both x and y. We assume that each mafia's own activity increases its illegal profits, that is, $\pi^1_x > 0$ and $\pi^2_y > 0$. Simultaneously, we incorporate the external effect between two mafias. Thus, π^1 is allowed to increase or decrease in y, and π^2 is allowed to increase or decrease in x. We distinguish two cases:

- complementarity: $\pi^1_y > 0, \pi^1_{xy} > 0, \pi^2_x > 0, \pi^2_{yx} > 0$;
- substitution: $\pi^1_y < 0, \pi^1_{xy} < 0, \pi^2_x < 0, \pi^2_{yx} < 0$·

Complementarity among mafias tends to hold, for example, if both mafias are subgroups and belong to the same mafia family. They share the same mafia brand, and each activity enhances the brand name, which increases each mafia's illegal profit. Additionally, one mafia group can acquire skills, knowledge, and information from another criminal organization to have effective criminal activities; see, for instance, Cavallaro et al. (2020) for detailed discussions of criminal network analysis. In these cases, each mafia faces positive externalities from other mafia activities. Substitution among mafias tends to hold, for example, if each mafia is in rival relations and competes for limited illegal profits, which indicates that each mafia's activity decreases the rival's profit. Thus, each mafia faces negative externalities from other mafia activities. Finally, we assume that $\pi^1_{xx} = 0, \pi^2_{yy} = 0$ for simplicity.

Let $c(x)$ and $c(y)$ be the cost functions for Mafias 1 and 2, respectively. It is natural to assume that c is increasing (i.e., $c_x > 0$ and $c_y > 0$). We also assume the convexity of the cost functions (i.e., $c_{xx} > 0$ and $c_{yy} > 0$). Additionally, the activities of each mafia are punished by the authority of the region in which the mafia commits illegal activities. Thus, Mafia i can be punished by the authority in Region i. Let s_i be the level of sanction by regional authority i. Thus, $s_1 x$ and $s_2 y$ are the expected sanctions for Mafias 1 and 2.[4] In summary, the objective function of each mafia is assumed to be given as follows:

$$M^1 = \pi^1(x, y) - c(x) - s_1 x,$$

and

$$M^2 = \pi^2(x, y) - c(y) - s_2 y.$$

Finally, we formulate the governments' objectives. Each government is concerned about the payoff of the mafia to some extent and attempts to minimize the social harm caused by illegal activities in its region and the cost of the clampdown. Let hx and hy ($h > 0$) be the social costs of illegal activities in Regions 1 and 2, respectively; these represent negative externalities of mafias' activities. For example, it includes external costs caused by the consumption of illegal drugs, the provision of illegal harmful service, the use of violence, and so on. Additionally, let $g(s_1)$ and $g(s_2)$ be sanction-related administration costs for 1 and 2. We assume that g are increasing, twice differentiable, and convex functions. In summary, each government's objective is given as follows:

$$W^1 = \alpha M^1 - hx - g(s_1),$$

and

[4] This assumption that law enforcement increases the expected per unit production costs of the criminal organizations follows articles such as (Chiu et al. 1998; Burrus 1999; Skott and Jepsen 2002), and Becker et al. (2006).

$$W^2 = \alpha M^2 - hy - g(s_2).$$

Notably, each government i is concerned about each mafias' payoff with α and selects s_i to maximize its total welfare. Here, $\alpha \in [0, 1]$ represents the extent to which the government considers mafia profits in social welfare; this setting is in line with the setting used by Konrand and Skapedas (1998), who examine the extortion behaviors of organized crime groups. This assumption has been controversial in law and economics literature since Stigler (1970) argued against it.[5] A positive α may imply that corrupted governments with criminal organizations consider a certain share of the mafia's profit in each region, which is considered a part of welfare, as discussed by Eboli et al. (2021) and other papers. Conversely, $\alpha = 0$ is likely to occur if it is morally acceptable to ignore mafias' welfare or if the governments consider the preference of median voters (e.g., victims) that are not likely to be a member of mafias. Whereas it is counterintuitive that the utility of a criminal group would be part of social welfare, it is reasonable for it to be part of social welfare if one sticks to Benthamite utilitarianism. Notably, this matter is not crucial for this study because our main results can be applied to both cases.

How does our model differ from standard frameworks of regulations (e.g., taxation or industrial organizations)? We emphasize two essential characteristics of our framework for criminal activities compared to such frameworks of regulation. First, local governments usually employ non-monetary sanctions, such as imprisonment, to arrest criminals and curb criminal organizations' activities whereas usual regulations on legal firms employ taxation. Thus, they simply engage in expensive law enforcement activities to reduce negative externality and do not always have tax revenue motivations. Second, although, usually, local governments consider the welfare of firms' profits in regulating their activities, our framework considers that they do always consider criminal organizations' profits, which is discussed above.

Let us explain the timing of the game. In the first stage, the governments in the two regions select s_1 and s_2 simultaneously. In the second stage, the two mafias decide their activity levels, x and y. We note that this setting, where government moves first, is common and important to explore the deterrence effects of law enforcement on curbing organized crime. This is especially important in law and economics literature exploring law enforcement on crime (Becker 1968; Polinsky and Shavell 2000; Garoupa 1997). For example, Garoupa et al. (2006), who offer the law and economics approach to terrorism from the deterrence perspective, mention that the economic model of crime and law enforcement relies on the balance between the benefits of offending and the respective costs in terms of severity of punishment, with respect to individuals (decision whether or not to commit a crime) and society (design on optimal law enforcement) to achieve efficient deterrence,

[5] Some authors, including (Lewin and Trumbull 1990; Friedman 1999), and Dau-Schmidt (1990), discuss the problem. For a recent argument, see Miceli (2022).

which is important to consider in controlling crimes by government law enforcement from the cost-benefit analysis perspective.[6]

3 Analysis

This section presents the main result of this study by solving the subgame perfect Nash equilibrium by backward induction.

3.1 Each mafia's choice of illegal activities

First, we examine the choice of each mafia in the second stage. By differentiating M^1 with respect to x, the first-order condition of Mafia 1's maximization problem is given as follows:

$$M_x^1 = 0 \iff \pi_x^1 - s_1 - c_x = 0. \tag{1}$$

Similarly, that of Mafia 2's maximization problem is given as follows:

$$M_y^2 = 0 \iff \pi_y^2 - s_2 - c_y = 0. \tag{2}$$

From the implicit function theorem, it follows that the slope of Mafia 1's (resp. Mafia 2's) best-response function is $\partial x/\partial y = \pi_{xy}^1/c_{xx}$ (resp. $\partial y/\partial x = \pi_{yx}^2/c_{yy}$). Thus, the best response function of each mafia is upward-sloping if the mafia's profit exhibits complementarity; it is downward-sloping if it exhibits substitution. Thus, this strategic relationship depends on the sign of π_{xy}^1 and π_{yx}^2. The selected activity levels, denoted by x^* and y^*, are determined to satisfy these two equations. These are functions of the actions s_1 and s_2 of the two governments. Thus, we denote them as $x^*(s_1, s_2)$ and $y^*(s_1, s_2)$.

We then show an auxiliary result, which comes from comparative statics with regard to x^* and y^*.

Lemma 1 (i) *x^* decreases in s_1 and x^* decreases* (*resp. increases*) *in s_2 if π^1 exhibits complementarity* (*resp. substitution*); (*ii*) *y^* decreases in s_2, and y^* decreases* (*resp. increases*) *in s_1 if π^2 exhibits complementarity* (*resp. substitution*).

Proof By applying the implicit-function theorem to (1) and (2), we obtain the following:

[6] If two mafias move first and the governments move second, the enforcement could not work to deter criminal activities. Thus, our setting is appropriate to explore deterrence effects on criminal organizations' activities.

$$\begin{pmatrix} M^1_{xx} = -c_{xx} & M^1_{xy} = \pi^1_{xy} \\ M^2_{yx} = \pi^2_{yx} & M^2_{yy} = -c_{yy} \end{pmatrix} \begin{pmatrix} \frac{\partial x^*}{\partial s_1} \\ \frac{\partial y^*}{\partial s_1} \end{pmatrix} = \begin{pmatrix} -M^1_{xs_1} = 1 \\ -M^2_{ys_1} = 0 \end{pmatrix}. \tag{3}$$

By solving this, it follows that

$$\frac{\partial x^*}{\partial s_1} = \frac{-c_{yy}}{c_{xx}c_{yy} - \pi^1_{xy}\pi^2_{yx}} < 0;$$
$$\frac{\partial y^*}{\partial s_1} = \frac{-\pi^2_{yx}}{c_{xx}c_{yy} - \pi^1_{xy}\pi^2_{yx}} \lesseqgtr 0 \iff \pi^2_{yx} \gtreqless 0.$$

In the same manner, we obtain the following:

$$\begin{pmatrix} M^1_{xx} = -c_{xx} & M^1_{xy} = \pi^1_{xy} \\ M^2_{yx} = \pi^2_{yx} & M^2_{yy} = -c_{yy} \end{pmatrix} \begin{pmatrix} \frac{\partial x^*}{\partial s_2} \\ \frac{\partial y^*}{\partial s_2} \end{pmatrix} = \begin{pmatrix} -M^1_{xs_2} = 0 \\ -M^2_{ys_2} = 1 \end{pmatrix}. \tag{4}$$

By solving this, it follows that

$$\frac{\partial x^*}{\partial s_2} = \frac{-\pi^1_{xy}}{c_{xx}c_{yy} - \pi^1_{xy}\pi^2_{yx}} \lesseqgtr 0 \iff \pi^1_{xy} \gtreqless 0;$$
$$\frac{\partial y^*}{\partial s_2} = \frac{-c_{xx}}{c_{xx}c_{yy} - \pi^1_{xy}\pi^2_{yx}} < 0.$$

□

The mechanism behind this result is as follows.[7] Each organization has the incentive to reduce its activity level in response to sanctions against it. What about the sanctions against the mafia in another region? For example, if the sanction s_1 becomes severe, Mafia 1 reduces its activity levels. If Mafias 1 and 2 are in a complementary relationship, the sanctions s_1 decrease Mafia 2's activity because of the reduction of Mafia 1's activity. Thus, if s_1 is higher, Mafia 1 has less incentive to commit illegal activities ($\partial x^*/\partial s_1 < 0$), which also discourages Mafia 2's activities ($\partial y^*/\partial s_1 < 0$). Of course, if s_2 is higher, Mafia 2 decreases its illegal activities ($\partial y^*/\partial s_2 < 0$), which discourages Mafia 1's activities ($\partial x^*/\partial s_2 < 0$).

Conversely, if mafias are in a substitute relationship, one region's punishment decreases the other region's mafia activity, which encourages another region's mafia activity. This is because once one mafia becomes weaker and disadvantaged, the rival mafia has a chance to expand its activities. Thus, if s_1 is higher, Mafia 1 has less incentive to commit illegal activities ($\partial x^*/\partial s_1 < 0$), which also encourages Mafia 2's activities ($\partial y^*/\partial s_1 > 0$). Additionally, if s_2 is higher, Mafia 2 has less incentive

[7] Because of our assumption in terms of π^1 and π^2, we have $\frac{\partial (x^*)^2}{\partial s_1 \partial s_2} = \frac{\partial (y^*)^2}{\partial s_1 \partial s_2} = 0$.

to commit illegal activities ($\partial y^*/\partial s_2 < 0$), which encourages Mafia 1's activities ($\partial x^*/\partial s_2 > 0$).

3.2 Each government's choice without coordination

Subsequently, we examine the choice of the government in the first stage. We note that the two governments face a simultaneous game, which is reduced from the entire extensive-form game; in this simultaneous game, the governments' choices of sanctions, s_1 and s_2, correspond to their strategy variables. Specifically, by substituting $x^*(s_1, s_2)$ and $y^*(s_1, s_2)$, we obtain $W^1(s_1, s_2)$ and $W^2(s_1, s_2)$, which are the payoff functions of the game in this stage. Furthermore, we assume that h is not extremely large or small to guarantee the interior solutions of x^*, y^*, and s_1, s_2. Therefore, the first-order condition associated with the government in Region 1 is given as follows:

$$W^1_{s_1} = \alpha \underbrace{\left(\pi^1_y \frac{\partial y^*}{\partial s_1} - x^*\right)}_{\frac{\partial M^1}{\partial s_1}} - h\left(\frac{\partial x^*}{\partial s_1}\right) - g_{s_1} = 0. \tag{5}$$

We assume that the second-order condition is satisfied, which can hold as long as $g_{s_1 s_1}$ is sufficiently large. Notably, severe punishment in Region 1 decreases Mafia 1's profit, which is confirmed by $\frac{\partial M^1}{\partial s_1} = \pi^1_y \frac{\partial y^*}{\partial s_1} - x^* < 0$. Additionally, severe punishment decreases the level of illegal activity and the associated social harm by Mafia 1 (i.e., $h\frac{\partial x^*}{\partial s_1} < 0$).

Similarly, the first-order condition of the government in Region 2 is given as follows:

$$W^2_{s_2} = \alpha \underbrace{\left(\pi^2_x \frac{\partial x^*}{\partial s_2} - y^*\right)}_{\frac{\partial M^2}{\partial s_2}} - h\left(\frac{\partial y^*}{\partial s_2}\right) - g_{s_2} = 0. \tag{6}$$

This also indicates that severe punishment in Region 2 decreases the profit and social harm of Region 2.[8]

We note that if each local government puts a lower weight on each mafia's welfare (a smaller α), then the enforcement tends to be strict. Finally, each local government's choice of sanctions, s_1^* and s_2^*, are determined to satisfy each first-order condition (5) and (6).[9]

[8] Here, we focus on the interior solutions. If h is considerably small, we are likely to have s_1^* and s_2^* as zero. However, if h is significantly large, we are likely to have s_1^* and s_2^* as large and x^* and y^* as zero.

[9] If two mafias move first, the enforcement could work to only reduce mafias' profit regarding $s_1 x$ or $s_2 y$. Thus, the interaction of how the governments affect criminal organizations to deter their activities is considerably simple.

3.3 Social welfare maximization

We consider the socially optimal sanctions that maximize the sum of the welfare levels of two regions (i.e., $SW = W^1 + W^2$); if the two governments address efficient bargaining, such optimal sanctions are achieved. (Durante and Gutiérrez 2013) offer a notable example of domestic inter-jurisdiction coordination provided. According to them, because a mayor has considerable influence over the selection of local police chiefs and the organization of police departments, each neighboring local government mayor's political party affiliation and alignment can have a considerable impact on coordinated enforcement, which is called horizontal inter-jurisdictional coordination of law enforcement. Another example of international law enforcement is explored by Sandler et al. (2011). According to them, Interpol fosters international police cooperation and coordinates each country member's police efforts to combat transnational organized crimes by providing multiple services, such as police training, secure communication networks, databases, and investigative resources, among member countries for various purposes.

The first-order conditions for this first-best maximization problem are as follows:

$$SW_{s_1} = \underbrace{\underbrace{\alpha\left(\pi_y^1\frac{\partial y^*}{\partial s_1} - x^*\right)}_{\frac{\partial M^1}{\partial s_1}} - h\left(\frac{\partial x^*}{\partial s_1}\right) - g_{s_1}}_{W^1_{s_1}} + \underbrace{\underbrace{\alpha\left(\pi_x^2\frac{\partial x^*}{\partial s_1}\right)}_{\frac{\partial M^2}{\partial s_1}} - h\left(\frac{\partial y^*}{\partial s_1}\right)}_{W^2_{s_1}} = 0, \tag{7}$$

and

$$SW_{s_2} = \underbrace{\underbrace{\alpha\left(\pi_y^1\frac{\partial y^*}{\partial s_2}\right)}_{\frac{\partial M^1}{\partial s_2}} - h\left(\frac{\partial x^*}{\partial s_2}\right)}_{W^1_{s_2}} + \underbrace{\underbrace{\alpha\left(\pi_x^2\frac{\partial x^*}{\partial s_2}\right) - y^*}_{\frac{\partial M^2}{\partial s_2}} - h\left(\frac{\partial y^*}{\partial s_2}\right) - g_{s_2}}_{W^2_{s_2}} = 0. \tag{8}$$

The optimal levels of sanctions, s_1^{**} and s_2^{**}, are determined to satisfy these simultaneous equations.[10] Although it can be difficult to obtain intuitive results from comp s_1^*, s_2^* and s_1^{**}, s_2^{**}, we attempt to make some relevant observations.

Let us discuss the comparison between s_1^* and s_1^{**}, which can be confirmed by the comparison of (5) and (7). First, if mafia activities are complementary (i.e., $\pi_y^1 > 0, \pi_{xy}^1 > 0, \pi_x^2 > 0, \pi_{yx}^2 > 0$;), s_1^* (resp. s_2^*) is lower than s_1^{**} (resp. s_2^{**}) if social harm h is large. The main difference between (5) and (7) is the effect of s_1 on W^2, that is, $W^2_{s_1} = \alpha\frac{\partial M^2}{\partial s_1} - h\frac{\partial y^*}{\partial s_1} = \alpha\left(\pi_x^2\frac{\partial x^*}{\partial s_1}\right) - h\left(\frac{\partial y^*}{\partial s_1}\right)$. As long as social harm reduction is the main object (i.e., large h), the sign of $\frac{\partial y^*}{\partial s_1}$ is crucial. According to the previous

[10] As we mentioned in the previous analysis, we consider the interior solutions. If h is extremely small or large, we are likely to have s_1^{**}, and s_2^{**} may be consistent with s_1^* and s_2^*.

analysis, one region's sanction discourages illegal activities in another region, that is, $\frac{\partial y^*}{\partial s_1} < 0$, if the mafias' activities are complementary (i.e., $\pi^1_y > 0, \pi^1_{xy} > 0, \pi^2_x > 0, \pi^2_{yx} > 0$). Therefore, the government in Region 1 has less incentive to spend more resources to reduce social harm compared to the social welfare level ($s^*_1 < s^{**}_1$). Conversely, if social harm reduction is not essential (i.e., not large h) because the effects of sanction s_1 on Mafia 2, that is, $M^2_{s_1} = \alpha\left(\pi^2_x \frac{\partial x^*}{\partial s_1}\right)$, are negative, the government in Region 1, without concern for Mafia 2's profit, may have more incentive to spend more resources on a clampdown compared to the social welfare level. We note that if each local government puts no weight on the benefit of each mafia (i.e., $\alpha = 0$), coordinated enforcement should be stricter compared to without coordination. This is because each law enforcement provides positive externalities on another region, which is effective to have fewer total criminal activities.

Second, if the mafias' activities are substitutes (i.e., $\pi^1_y < 0, \pi^1_{xy} < 0, \pi^2_x < 0, \pi^2_{yx} < 0$), s^*_1 (resp. s^*_2) is higher than s^{**}_1 (resp. s^{**}_2) if social harm h is large. This can also be confirmed by the comparison of (5) and (7). As long as social harm reduction is the main object (i.e., large h), the sign of $\frac{\partial y^*}{\partial s_1}$ is positive if the mafias' activities are substitutes (i.e., $\pi^1_y < 0, \pi^1_{xy} < 0, \pi^2_x < 0, \pi^2_{yx} < 0$). Therefore, the government in Region 1 has more incentive to spend resources to reduce social harm compared to the social welfare level ($s^*_1 > s^{**}_1$). However, if social harm reduction is not important (i.e., not large h) because the effects of sanction s_1 on Mafia 2, that is, $M^2_{s_1} = \alpha\left(\pi^2_x \frac{\partial x^*}{\partial s_1}\right)$, are positive, the government in Region 1, without concern for Mafia 2's profit, may have less incentive to spend more resources on a clampdown compared to the social welfare level. These mechanisms also hold for the optimal condition of the government in Region 2. We note that if each local government does not consider the welfare of each mafia (i.e., $\alpha = 0$), coordinated enforcement can be laxer compared to without coordination to reduce the unnecessary occurrence of total criminal activities because of negative external effects of law enforcement on another region.

In summary, we have the following proposition.

Proposition 1 (i) *If the mafias' payoffs exhibit complementarity, the equilibrium sanction level without coordination is lower than the first-best sanction level with coordination.* (*ii*) *If the mafias' payoffs exhibit substitution, the equilibrium sanction level without coordination is higher than the first-best sanction level with coordination.*

Intuitively, the complementarity relations of mafias indicate that each government's enforcement induces positive external effects on the other government, which leads to the so-called "free-rider problems" between the governments as in public provision games and under-provision for the choice of enforcement. This is because, while an increase in one government's sanction contributes to an enhancement of the welfare level in the other region by reducing illegal activities, self-interested local governments do not consider a positive externality in their choice. Thus, a

policy implication from our result is that, if local governments fight against organized crime groups that are complementary relations, more enforcement should be required to enhance efficiency. Additionally, our result is empirically relevant. For example, the complementarity relations among organized crime groups are likely to occur if international law enforcement agencies tackle the common transnational terrorist group and employ multilateral counterterrorism. To mitigate the inefficiency due to the aforementioned free-rider problem among governments or countries, some international organizations may play a crucial role in enhancing international cooperation against transnational crimes. For example, Interpol coordinates cooperation between countries to curb transnational criminal activities by providing multiple services, such as police training and communication networks among member countries. Related to this, some empirical evidence supports the effectiveness of coordinated enforcement provided by Interpol. Sandler et al. (2011) estimate that for every dollar invested in Interpol's counterterrorism activities, member countries receive 200 dollars in average returns, which indicates that Interpol plays a crucial role in international cooperation. Gardeazabal and Sandler (2015) also investigate the effects of Interpol's surveillance, such as the Mobile Interpol Network Database (MIND) and the Fixed Interpol Network Database (FIND), and show that countries adopting MIND/FIND experienced fewer transnational terrorist attacks. From a different perspective, international cooperation is essential in curbing maritime crimes such as piracy, illegal fishing, and smuggling. Phayal et al. (2022) investigate the effects of the conflict among sea-boundaries states on effective maritime crime controls. They demonstrate that when states get involved in military disputes, the likelihood of pirate attacks in territorial waters increases. However, more security cooperation among bordering states lowers such criminal activities. These indicate that international cooperation could be effective in solving collective action problems and curbing several transnational crimes.

The situation drastically changes in the case of substitution. An increase in the sanctions by one government makes the mafia in the other region more active and provides negative externalities on the other government. This suggests that the government faces a problem similar to the tragedy of common problems such as air pollution, which causes negative externality and the unnecessary occurrence of illegal activities in other regions from the social welfare perspective. A policy implication from our result is that if local governments fight against organized crime groups that have conflicting relations, less enforcement is required to avoid unnecessary occurrences of crimes, which enhances efficiency. The substitution case is empirically relevant, as in the case of complementarity. For example, substitution relations among organized crimes are likely to occur among several rivaling and competitive drug trafficking cartels in Mexico. Dell (2015) demonstrates that violence reflects rival traffickers' attempt to usurp territories after crackdowns have weakened incumbent criminals in Mexico, which indicates the substitution relations among drug cartels. In this respect, (Durante and Gutiérrez 2013) consider that because a mayor has considerable influence over the selection of enforcement, each neighboring local government mayor's political party affiliation and alignment can have a considerable impact on coordinated enforcement. Thus, they show that horizontal inter-jurisdictional coordination across politically aligned neighboring municipalities in Mexico can reduce drug violence. Rios (2015) also indicates that the

democratization of Mexico associated with the breakdown of the single-party hegemony decreases the coordination among every level of local government and causes violent wars between drug cartels. These are consistent with our prediction that coordinated enforcement helps reduce unnecessary violence occurrences caused by negative externalities among each local government.

We present examples using specified functions to highlight the above results. Let us fix the profit and cost functions as follows:

$$M^1 = \pi_1(x, y) - c(x) - s_1 x = ax + exy - x^2 - s_1 x;$$
$$M^2 = \pi_2(x, y) - c(y) - s_2 y = ay + exy - y^2 - s_2 y;$$
$$W^1 = \alpha M^1 - hx - \frac{c(s_1)^2}{2}, \quad W^2 = \alpha M^2 - hy - \frac{c(s_2)^2}{2}.$$

The first and second lines represent the specification for the mafias' payoffs, whereas the third line represents that for each government with enforcement cost $c(s_i)^2/2$. These specifications are consistent with our assumptions imposed over the payoff and cost functions, where $e > 0$ and $e < 0$ represent the complementary and substitution relations, respectively. Considering that the payoffs of mafias and the governments' payoffs are symmetric, we can focus on the symmetric equilibrium under this specification.

The best response functions of Mafias 1 and 2 are given as follows:

$$B_1(y) = \frac{a + ey - s_1}{2} \text{ and } B_2(x) = \frac{a + ex - s_2}{2}.$$

By solving the equations associated with mafias' maximization problems, we obtain the following:

$$x^* = \frac{(2 + e)a - 2s_1 - es_2}{4 - e^2} \text{ and } y^* = \frac{(2 + e)a - 2s_2 - es_2}{4 - e^2}.$$

By substituting them into the governments' objectives, the first-order conditions for the equilibrium sanctions are as follows:

$$W^1_{s_1} = 0 \iff \alpha\left(ex^* \frac{-e}{4 - e^2} - x^*\right) - h\frac{-2}{4 - e^2} - cs_1 = 0;$$
$$W^2_{s_2} = 0 \iff \alpha\left(ey^* \frac{-e}{4 - e^2} - y^*\right) - h\frac{-2}{4 - e^2} - cs_2 = 0.$$

By solving these simultaneous equations, we obtain the sanction levels in equilibrium as follows:

$$s^* = s_1^* = s_2^* = \frac{2h(2 - e) - 4\alpha a}{c(2 + e)(2 - e)^2 - 4\alpha}.$$

To guarantee the interior solution, it should be the case that $2h(2 - e) - 4\alpha a > 0$ and $c(2 + e)(2 - e)^2 - 4\alpha > 0$. This is satisfied as long as α is sufficiently small and h and c are not small.

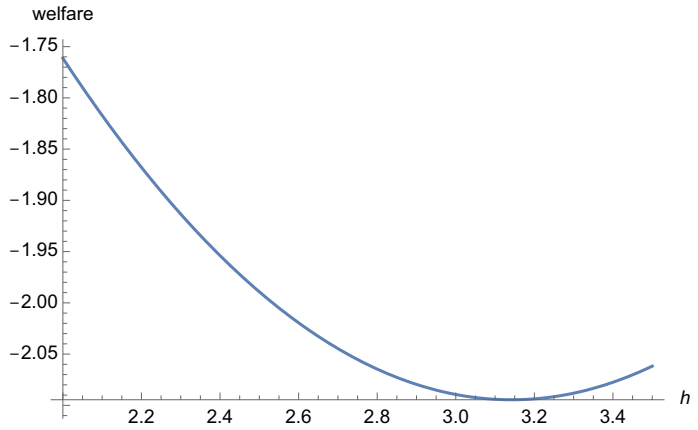

Fig. 1 Non-monotonic relationship between h and W^* ($a = 2$, $e = 0.5$, $c = 1$, and $\alpha = 0.5$)

We consider the welfare implication. First, we demonstrate that a counterintuitive result holds under a strategic crackdown by the government. As alluded to above, s_1^* and s_2^* are dependent on h. Define

$$W^* = W^1(s_1^*(h), s_2^*(h)) = W^2(s_1^*(h), s_2^*(h)).$$

That is, W^* is the equilibrium social welfare. Specifically, the value of W^* becomes the following under our specification:[11]

$$W^* = \frac{a^2\alpha c\Big(c\big(4-e^2\big)^2-8\alpha\Big) - ac(2-e)h\Big(c\big(4-e^2\big)^2-8\alpha\Big) + 2h^2\big(c(2-e)^2(1+e)-2\alpha\big)}{\big(c(2-e)^2(2+e)-4\alpha\big)^2}.$$

Thus, by differentiating this with respect to h, we obtain the following:

$$\frac{dW^*}{dh} = \frac{-ac(2-e)\Big(c\big(4-e^2\big)^2-8\alpha\Big) - 8\alpha h + 4c(1+e)(2-e)^2h}{\big(c(2-e)^2(2+e)-4\alpha\big)^2}.$$

Although the sign of $\frac{dW^*}{dh}$ is ambiguous from this equation, equilibrium social welfare W^* increases with h where we assume h is not sufficient to have interior solutions of x^* and y^* if

$$h > \frac{ac(2-e)\big(8\alpha - ce^4 + 8ce^2 - 16c\big)}{4\big(2\alpha - ce^3 + 3ce^2 - 4c\big)}.$$

[11] Mathematica, Version 12.0 (Wolfram Research 2019) is used for deriving W^*, dW^*/dh, and Fig. 1.

Figure 1 shows this counterintuitive case. A U-shape is observed. As h increases, the equilibrium social welfare decreases; however, once it reaches the bottom, an increase in h enhances the equilibrium social welfare.

Let us explain the policy implication of this observation. Notably, because h represents the marginal damage of illegal activities by organized crime groups, an increase in h must be harmful. Although some policy interventions, such as notification of scams and other organized crimes to consumers and the government's reallocation of its resources to protect consumers from organized crime to reduce the size of h, can affect this marginal damage, they may reduce the equilibrium social welfare (consider a move from $h = 3.5$ to $h = 3.3$ in Fig. 1). This observation also implies that as long as a reduction in h is substantial (e.g., a move from $h = 3.5$ to $h = 1.5$), the equilibrium social welfare is safely enhanced.

We compare the equilibrium results with the first-best results. The first-order conditions of the first-best problem are as follows:

$$SW_{s_1} = 0 \iff \alpha\left(ex^* \frac{-e}{4-e^2} - x^*\right) - h\frac{-2}{4-e^2} - cs_1 + \alpha\left(ey^* \frac{-2}{4-e^2}\right) - h\frac{-e}{4-e^2} = 0;$$
$$SW_{s_2} = 0 \iff \alpha\left(ex^* \frac{-2}{4-e^2}\right) - h\frac{-e}{4-e^2} + \alpha\left(ey^* \frac{-e}{4-e^2} - y^*\right) - h\frac{-2}{4-e^2} - cs_2 = 0.$$

By solving these simultaneous equations, we obtain the first-best sanction level as follows:

$$s_1^{**} = s_2^{**} = \frac{h(2-e) - 2\alpha a}{c(2-e)^2 - 2\alpha}.$$

Thus, assuming that h is sufficiently large to have interior solutions, if $e > 0$, we have $s^{**} > s^*$, and if $e < 0$, we have $s^{**} < s^*$ as long as both are interior solutions. This confirms Proposition 1.

Finally, we explain the background mechanism behind the U-shape. Notably, because an increase in h makes the governments select strict enforcement, each mafia's choice of illegal activity decreases and approaches zero as h increases. This can lead to social welfare enhancement. However, because an increase in h reduces the mafia's profit in equilibrium, as long as the beneficial effect of the harm reduction dominates the negative effect associated with the reduction of the mafia's profit, the social welfare is improved.

4 Extensions

This section briefly considers three extensions of the basic model in the previous section. First, we consider the case of a high-level decision-maker in criminal organizations. This is especially the case where, under the complementarity relations between mafias, we may have a high-level decision maker of criminal organizations, such as a higher-ranked boss to dictate and coordinate each mafia's activity to internalize their externality. In this case, each mafia increases activities because they consider other mafias' profits. Let us assume that $\tilde{x}$ and $\tilde{y}$ are selected to

maximize the joint objective functions $M^1 + M^2$. In this case, for example, if the local government 1 selects stricter enforcement s_1, the mafia in Region 1 activity $\tilde{x}$ is significantly smaller because Mafia 1 also considers the effects on Mafia 2's welfare.[12] Consequently, under complement relations, strict enforcement on Mafia 1 s_1 also reduces Mafia 2's activity $\tilde{y}$. Therefore, the effects of each local government's stricter enforcement can be more remarkable if there is a high-level decision maker, such as a higher-ranked boss, to coordinate each mafia's activities. Thus, each local government has more incentive to set stricter enforcement to curb criminal activities.

Second, even if the higher government cannot fully control each local government's behavior, introducing positive/negative subsidies provided by the higher government can lead to efficient outcomes. For example, if each local government i obtains positive/negative subsidy payment $t_i s_i$, where the higher government provides t_i per s_i to each local government i, each local government's objective function becomes

$$W^1 = \alpha M^1 - hx + t_1 s_1 - g(s_1),$$
$$W^2 = \alpha M^2 - hy + t_2 s_2 - g(s_2).$$

Thus, the first-order condition associated with the government in Regions 1 and 2 is given as follows:

$$W^1_{s_1} = \alpha \underbrace{\left(\pi^1_y \frac{\partial y^*}{\partial s_1} - x^*\right)}_{\frac{\partial M^1}{\partial s_1}} - h\left(\frac{\partial x^*}{\partial s_1}\right) + t_1 - g_{s_1} = 0. \tag{9}$$

$$W^2_{s_2} = \alpha \underbrace{\left(\pi^2_x \frac{\partial x^*}{\partial s_2} - y^*\right)}_{\frac{\partial M^2}{\partial s_2}} - h\left(\frac{\partial y^*}{\partial s_2}\right) + t_2 - g_{s_2} = 0. \tag{10}$$

Thus, by comparing the first-order conditions of (7) and (8), optimal t_1^{**} and t_2^{**} can exist to achieve efficient outcomes using subsidies.

Finally, we consider a case where the two governments sequentially select sanction levels where one of the local governments moves first. This analysis is relevant for numerous actual cases. If there is a country that uses leadership to curb transnational organized crimes, such as employing counterterrorism and enforcement on drug trafficking, this analysis provides meaningful implications. The United States has been more aggressive than other countries in bolstering antiterrorist measures since the September 11 attacks (Sandler and Siqueira 2006). Another example is

[12] Mathematically, it holds that $\partial\tilde{x}/\partial s_1 = -c_{yy}/[c_{xx}c_{yy} - (\pi^1_{xy} + \pi^2_{yx})^2] < 0$ and $\partial\tilde{y}/\partial s_1 = -(\pi^1_{xy} + \pi^2_{yx})/[c_{xx}c_{yy} - (\pi^1_{xy} + \pi^2_{yx})^2] < 0$. Thus, we can confirm that the effect of enforcement becomes larger.

related to local elections. There are numerous cases where local elections are not held simultaneously. In such cases, if a new mayor takes office in one municipality and changes enforcement levels, this affects other local governments. Other local governments cannot change their policies by responding to the new mayor's choices immediately because it can be costly. Thus, this is appropriate for short-term policy analysis. Dell (2015) argues that a new mayor of the conservative party in Mexico employs strict enforcement after taking an office, and this affects drug trafficking groups' actions in the municipality and in other neighboring municipalities. Specifically, we assume that the government in Regions 1 and 2 move first and second, respectively; after observing s_1 and s_2, the mafias in the two regions determine their activity levels simultaneously. We note that the reaction functions of mafias are the same; thus, $x^*(s_1, s_2)$ and $y^*(s_1, s_2)$ determined by (1) and (2) are the equilibrium behaviors for this case. Moreover, the first-order condition of the government in Region 2, which is the second mover, is the same as (5). Let $\hat{s}_2(s_1)$ be the best response function of the government in Region 2. A crucial difference is observed in the maximization problem of the government in Region 1, which considers the response of the government in Region 2. Thus, the first-order condition is denoted as follows:

$$W^1_{s_1} = 0 \iff \underbrace{\alpha\left[\pi^1_y\left(\frac{\partial y^*}{\partial s_1} + \frac{\partial y^*}{\partial s_2}\frac{\partial \hat{s}_2}{\partial s_1}\right) - x^*\right]}_{\frac{\partial M^1}{\partial s_1}} - h\left(\frac{\partial x^*}{\partial s_1} + \frac{\partial x^*}{\partial s_2}\frac{\partial \hat{s}_2}{\partial s_1}\right) - g_{s_1} = 0 \tag{11}$$

Although it can be complicated to have intuitive results from this condition, we attempt to provide some implications. To derive the clear-cut result for the case with the sequential move, we investigate the reaction of the government in Region 2. According to the first-order condition of the government in Region 2 (equation (6)), the sign of $\frac{\partial \hat{s}_2}{\partial s_1}$ depends on the sign of $W_{s_2 s_1}$.[13] Thus, comparative statics indicates that

$$W^2_{s_2 s_1} = \frac{\partial y^*}{\partial s_1}\left(\alpha \pi^2_{xy}\frac{\partial x^*}{\partial s_2} - 1\right). \tag{12}$$

First, the previous analysis indicates that if mafias are in a complementary relationship with $\pi^1_{xy} > 0$ and $\pi^2_{xy} > 0$, we have $\partial x^*/\partial s_2 < 0$ and $\partial y^*/\partial s_1 < 0$. Therefore, we have $\frac{\partial \hat{s}_2}{\partial s_1} > 0$. However, if mafias are in a substitution relationship with $\pi^1_{xy} < 0$ and $\pi^2_{xy} < 0$, we have $\partial x^*/\partial s_2 > 0$ and $\partial y^*/\partial s_1 > 0$. Therefore, we have $\frac{\partial \hat{s}_2}{\partial s_1} < 0$.

Moreover, certain different implications from the previous situations with simultaneous moves exist. Particularly, we focus on implications for harm reduction. The primary difference from (5) and (11) in terms of harm reduction is $h\left(\frac{\partial x^*}{\partial s_2}\frac{\partial \hat{s}_2}{\partial s_1}\right)$. Our results indicate that in both cases with "substitution" and "complementary" relations, we have $h\left(\frac{\partial x^*}{\partial s_2}\frac{\partial \hat{s}_2}{\partial s_1}\right) < 0$. Therefore, the government that

[13] This is because the comparative static indicates $\partial \hat{s}_2/\partial s_1 = -W_{s_2 s_1}/W_{s_1 s_1}$, where $W_{s_1 s_1} < 0$.

moves first (i.e., the government in Region 1) has an incentive to make more effort to reduce social harm in sequential than in simultaneous move games. This is because, in the case of the "substitution" relation, severe punishment by the leader government in Region 1 can induce more punishment of the follower government in Region 2, which decreases the mafia's activity in the region of the leader government. Conversely, in the case of the "complementary" relation, severe punishment by the leader government can discourage punishment by the follower government, which also decreases the mafia's activity in the region of the leader government. In each situation, each local mafia's profit decreases, which indicates that, the local government's concern about the local mafia's profit affects lax enforcement policies.

5 Concluding remarks

This study examined how the interactions of governments yield coordination failures of sanctions in their territories when each government attempts to control the activities of organized crime groups in its territory. We discovered that collaborative relations between organized crime groups lead to the positive externality of one region's law enforcement on another neighboring region's enforcement, which is a type of free-rider problem similar to providing public goods between local governments (i.e., under-enforcement). However, competitive relations between organized crime groups lead to the negative externality of one region's law enforcement on another neighboring region's enforcement, which is the tragedy of common problems such as air pollution problems between local governments (i.e., over-enforcement).

Our analysis can be considered the first step toward the development of a strategic approach to eradicate organized crime. Our model can be extended in various directions. For instance, throughout this paper, we assume that there is only one organized crime group in one region. However, in reality, multiple organizations perform harmful activities. Moreover, organized crime groups in the same region could be collaborative (complementary), whereas organized crime groups in different regions could be competitive (substitutes). This is a natural extension of our model. For another extension, one may consider the case where some organized crime groups move first and others follow the first movers. Thus, there are leading organized crime groups, and therefore, this type of extension is also plausible. Such attempts remain for future research.

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Declarations

Conflict of interest We declare no conflict of interests.

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