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Strategic crackdown on organized crime by local governments

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Abstract. This paper examines strategic crackdown policies between states or nations. More precisely, we consider how organized crime in different regions can affect optimal sanctions for local governments, which face the problem of coordination failure. Our focus is to show how the strategic relation between mafias (i.e., complementarity or substitution) stipulates the strategic relation between local governments with respect to crackdown on organized crime. We show that if mafias' activities are complementary/collaborative, then the equilibrium sanction level without coordination is lower than the first-best sanction level with coordination and that if mafias' activities are substitutive/competitive, then the equilibrium sanction level without coordination is higher than the first-best sanction level with coordination.

Keywords: organized crime, mafia, complementarity, substitution, sanction

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1 Introduction

Organized crime have recently caused a dire hazard in many countries, whether they are developed or developing countries; organized crime have become more severe under social crises, such as the COVID-19 pandemic. *Global Organized Crime Index 2021* defines 'organized crime' as "illegal activities, conducted by groups or networks acting in concert, by engaging in violence, corruption or related activities in order to obtain, directly or indirectly, a financial or material benefit" (page 23).[1] Agents in question are criminal organizations, such as mafias, gangs, mobs, and syndicates, that engage in a variety of harmful activities, e.g., providing illegal goods and services such as drug trafficking, migrant smuggling, human trafficking, firearms trafficking, illegal gambling, extortion with the use of violence, and so on. Authorities, such as police organizations and governments, try to eradicate these detrimental activities by employing law enforcement strategies.

This paper investigates fundamental issues regarding law enforcement strategies against criminal organizations. To do so, two elements are incorporated. The first is an interaction/strategic relation among criminal organizations. To incorporate this, two classes of relations can be distinguished. For example, consider two mafias that independently commit activity such as fighting for territory or providing illegal goods and services to increase their own illegal profit and decrease other mafias' profits. Rivalry is expected between mafias in this example. We label this class "substitution." On the other hand, it may be the case that one mafia's activity increases not only its own profits but also other mafias' profits. This can be labeled a "complementary" relation, which tends to hold if each criminal organization is a subgroup of one mafia family and each clan's action can enhance the brutality reputation of the mafia family and acquire more illegal profits. For example, there are some mafia-type criminal organizations in Italy, such as Cosa Nostra, 'Ndrangheta and Camorra that are confederations of subgroups and clans; see Paoli (2014). Rivalry across these mafias encourages competition. Thus, a clan has an incentive to compete with other mafias' clans and dominate them. Additionally, cooperation among subgroups that belong to the same mafia family is likely to occur. In this case, each clan has an incentive to help other clans in the same mafia family. Additionally, cooperative relations among criminal organizations can be found in 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) and Japanese Mafia ("Yakuza") and emerging loosely organized groups (Schreiber 2012). Therefore, depending on activities and situations, their "complemen-

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

tary" and "substitution" relations can be varied. If competition among these clans is fierce, the "substitution" effect dominates the "complementarity" effect; this means that the relation among clans becomes a substitute. On the other hand, if such competition is not strong, each clans activity has "complementary" characteristics.

This interaction between criminal organizations is not the only type of strategic relation. As the second element, we consider an interaction among law enforcement authorities. Criminal organizations in Italy such as Cosa Nostra, 'Ndrangheta and Cammora mentioned above engage in illegal business not only in their home region but also outside. This interregional nature is commonly observed in many criminal organizations. Then, different clans in one mafia can be targeted by different local law enforcement authorities. This creates a coordination problem for local governments. This is almost inevitable because the local government's discretion does not have much discretion beyond their territories. For example 'Ndrangheta exercises worldwide influence despite its origination in Calabria in Italy. To crack down on their activities, international law enforcement approaches are currently employed.[2] Without a doubt, an analogous issue arises even in the case of domestic law enforcement when criminal organizations operate across states under a decentralized political system, i.e., federal systems.

By incorporating the aforementioned two elements, we provide a formal framework to consider interactions among local criminal organizations and local law enforcement authorities. To be precise, we introduce two local criminal organizations (clans or different mafias) and two local law enforcers (governments). Each local mafia provides illegal goods and services by using violence to make illegal profits; and each local mafia's activities cause a negative externality in its local region. In response, each local government employs its law enforcement strategies against only the local mafia to reduce the negative external effects. Furthermore, we consider that each local mafia's actions affect the other mafia's profit. The Mafias' activities are complementary/collaborative if each mafia's activity provides a positive externality for the other mafia; in contrast, their activities are substitutive/competitive if each mafia's activity provides a negative externality for other mafia. As mentioned above, both cases are possible depending on the context.

This paper shows that each local government's behavior causes inefficient law enforcement policies. Notably, sanctions can be either too strong or too weak. Under mafia complementarity, the equilibrium sanction level without coordination is lower than the first-best sanction level with coordination; under substitution conditions, the equilibrium sanction level without coordination

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

is higher than the first-best sanction level with coordination. Furthermore, 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 suffer from mafias' activities have an incentive to set severe law enforcement policies to extract more effective enforcement strategies for other regions. These results indicate that strengthening law enforcement strategies among countries by enacting international agreements does not always lead to efficient outcomes.

Our analysis is closely related to two lines of research in the literature in law and economics. First, this paper contributes to the economic analysis of criminal organizations.[3] Notably, since Becker (1968) established an economic analysis of illegal activities by individuals, most previous works 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) to name but a few. However, this paper 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 its welfare implications remain uncertain. Moreover, Yahagi (2019) considers how cooperation among criminal organizations emerges, while Flores (2016) considers 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 through the use of violence. As a novel contribution, we extend these papers' 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.

Second, this paper 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 choice and strategic rela-

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

tions 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. Since these papers do not consider complementarity or substitution among criminal organizations, we provide different implications for law enforcement policies.

The rest 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 mafias and governments. There are two regions ($i = 1, 2$); these regions can be interpreted as states or nations. In each region, one group of mafia engages in illegal activities, such as providing illegal goods and service and engaging in violent activities such as extortion. The activity level of mafia 1 is denoted by x, while that of mafia 2 is denoted by y. These are nonnegative real numbers. Each region has its own government that clamps down on illegal activities.

Let π^i be the illegal revenue of mafia i. Each π^i depends both on x and y. We assume that each mafia's own activity increases its illegal revenue, i.e., $\pi^1_x > 0$ and $\pi^2_y > 0$. At the same time, we incorporate the external effect between two mafias. That is, 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 enhances each mafia's illegal profit. That is, 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 hurts the rival's profit. That is, each mafia faces negative externalities from other mafia activities. Finally, we assume that $\pi^1_{xx} = 0, \pi^2_{yy} = 0$. This assumption is 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 $c_{yy} > 0$). In addition, the activities of each mafia are punished by the authority of the region in which the mafia commits to illegal activities. That is, 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_1x and s_2y are the expected sanctions for mafia 1 and mafia 2.[4] In sum, the objective function of each mafia is assumed to be given as follows:

$$M^1 = \pi^1(x, y) - c(x) - s_1x,$$

and

$$M^2 = \pi^2(x, y) - c(y) - s_2y.$$

Finally, we formulate the governments' objectives. Each government cares for the payoff of the mafia to some extent and tries to minimize the social harm caused by illegal activities in its region and the cost of 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 the clampdown costs for 1 and 2. We assume that g are increasing, twice differentiable, and convex functions. In sum, each government's objective is given as follows:

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

and

$$W^2 = \alpha M^1 - hy - g(s_2).$$

Each government i cares each mafias' payoff with α and chooses s_i to maximize its total welfare. Here, $\alpha \in [0, 1]$ represents the extent to which the government takes mafia profits into account in social welfare. It is assumed to be non-negative. Notably, a positive α implies that a certain share of the mafia's profit in each region is taken into account as a part of welfare. Although this assumption can be controversial, our main results are valid even when the government ignores the mafias' profits.

The timing of the game is as follows. In the first stage, the governments in the two regions choose s_1 and s_2 simultaneously. In the second stage, the two mafias decide their activity levels, x and y.

[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).

3 Analysis

This section offers 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

We first 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:

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

Analogously, 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. $\partial y/\partial x = \pi_{yx}^2/c_{yy}$). That is, the best response function of each government 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 chosen activities 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 now show an auxiliary result, which comes from comparative statics with regard to x^* and y^*.

Lemma 1. (i) x^* is decreasing in s_1 and x^* is decreasing (resp. increasing) in s_2 if π^1 exhibits complementarity (resp. substitution); (ii) y^* is decreasing in s_2, and y^* is decreasing (resp. increasing) 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:

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

By solving this, it follows that

$$\begin{aligned} \frac{\partial x^*}{\partial s_1} &= \frac{-c_{yy}}{c_{xx}c_{yy} - \pi_{xy}^1 \pi_{yx}^2} < 0; \\ \frac{\partial y^*}{\partial s_1} &= \frac{-\pi_{yx}^2}{c_{xx}c_{yy} - \pi_{xy}^1 \pi_{yx}^2} \lesseqgtr 0 \iff \pi_{yx}^2 \gtreqless 0. \end{aligned}$$

In the same way, 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.[5] It is obvious that each organization has an incentive to reduce its activity level in response to sanctions against it. How 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 mafia 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. That is, 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 also discourages mafia 1's activities ($\partial x^*/\partial s_2 < 0$).

On the other hand, if mafias are in a substitute relationship, one region's punishment decreases this region's mafia activity, which also encourages the other region's mafia activity. This is because once one mafia becomes weaker and is at a disadvantage, the rival mafia has a chance to expand its activities. That is, 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 to commit illegal activities ($\partial y^*/\partial s_2 < 0$), which also 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 govenments' choices of sanctions, s_1 and s_2, correspond to their strategy variables. To be precise, by substituting $x^*(s_1, s_2)$ and $y^*(s_1, s_2)$, we obtain $W^1(s_1, s_2)$

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

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. Then, 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 large enough. 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., $h\frac{\partial x^*}{\partial s_1} < 0$).

Analogously, 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.[6] Each local government's choice of sanctions, s^*_1 and s^*_2, are determined to satisfy each first-order condition (5) and (6).

3.3 Social welfare maximization

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

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

and

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

[6] Here, we focus on the interior solutions. If h is too small, we are likely to have s^*_1 and s^*_2 tends to be zero. On the other hand, if h is too large, we are likely to have s^*_1 and s^*_2 also tends to be large and x^* and y^* can be zero.

The optimal levels of sanctions, s_1^{**} and s_2^{**}, are determined to satisfy these simultaneous equations.[7] Although it can be difficult to obtain intuitive results from comparison s_1^*, s_2^* and s_1^{**}, s_2^{**}, we try 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, i.e., $W_{s_1}^2 = \alpha \frac{\partial M^2}{\partial s_1} - h\frac{\partial y^*}{\partial s_1} = \alpha\left(\pi_x^2 \frac{\partial x^*}{\partial s_1}\right) - h\left(\frac{\partial y^*}{\partial s_1}\right)$. As long as social harm reduction is the main object (i.e., large h), the sign of $\frac{\partial y^*}{\partial s_1}$ is important. According to the previous analysis, one region's sanction also discourages illegal activities in another region, i.e., $\frac{\partial y^*}{\partial s_1} < 0$, if the mafias' activities are complementary (i.e., $\pi_y^1 > 0, \pi_{xy}^1 > 0, \pi_x^2 > 0, \pi_{yx}^2 > 0$). Therefore, the government in region 1 has less incentive to spend more resources to reduce social harm compared to the social welfare level ($s_1^* < s_1^{**}$). On the other hand, if social harm reduction is not important (i.e., not large h), since the effects of sanction s_1 on mafia 2, i.e., $M_{s_1}^2 = \alpha\left(\pi_x^2 \frac{\partial x^*}{\partial s_1}\right)$, 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.

Second, if the mafias' activities are substitutes (i.e., $\pi_y^1 < 0, \pi_{xy}^1 < 0, \pi_x^2 < 0, \pi_{yx}^2 < 0$), 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 substitutive (i.e., $\pi_y^1 < 0, \pi_{xy}^1 < 0, \pi_x^2 < 0, \pi_{yx}^2 < 0$). Therefore, the government in region 1 has more incentive to spend resources to reduce social harm compared to the social welfare level ($s_1^* > s_1^{**}$). On the other hand, if social harm reduction is not important (i.e., not large h), since the effects of sanction s_1 on mafia 2, i.e., $M_{s_1}^2 = \alpha\left(\pi_x^2 \frac{\partial x^*}{\partial s_1}\right)$, are positive, then 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.

In summary, we have the following proposition.

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

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

Intuitively, the first result means that the government faces the so-called "free-rider problem" for the choice of sanction in the case of complementarity. This is basically because an increase in one government's sanction contributes to the welfare level in the other region by reducing illegal activities in both regions. That is, sanctions become public goods under the complementarity of mafias. This is an intuitive reason why sanctions become insufficient. The situation drastically changes for the case of substitution. An increase of the sanctions by one government makes the mafia in the other region more active. This suggests that the government faces a problem similar to air pollution in the case of substitution. This is why equilibrium sanctions are excessive from the point of view of social welfare.

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

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

The first and second lines represent the specification for the mafias' payoffs, while the third line represents that for the governments. These specifications are consistent with our assumptions imposed over the payoff and cost functions, where e represents the complementary relation with $e > 0$ and the substitution relation with $e < 0$. Notably, the payoffs of mafias are symmetric, and the governments' payoffs are symmetric. Therefore, we can focus on the symmetric equilibrium under this specification. The best response functions of mafia 1 and mafia 2 are given as follows:

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

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:

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

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.

Now, 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. More precisely, the value of W^* becomes the following under our specification:[8]

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

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

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

The sign of $\frac{dW^*}{dh}$ is ambiguous from this equation. Notably, if there is no strategic relationship, the absolute size of the negative effect, h, of illegal activities must be negatively correlated with equilibrium social welfare. Indeed, a nonmonotonic relationship can hold, depending on the parameters. Note that W^* increases with h if

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

Of course, the corner solution is reached for too large h. However, for some parameters, there is an interval of h where this inequality holds, and x^* and y^* are positive. Figure 1 shows this counterintuitive case. The U-shape is observed. As h rises, the equilibrium social welfare falls, but once it reaches the bottom, an increase in h enhances the equilibrium social welfare.

Let us explain the policy implication of this observation. Notably, h represents the marginal damage of illegal activities by mafias or the severity of their organized crime. Therefore, an increase in h itself must be harmful. This marginal damage can be dependent on various factors.

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

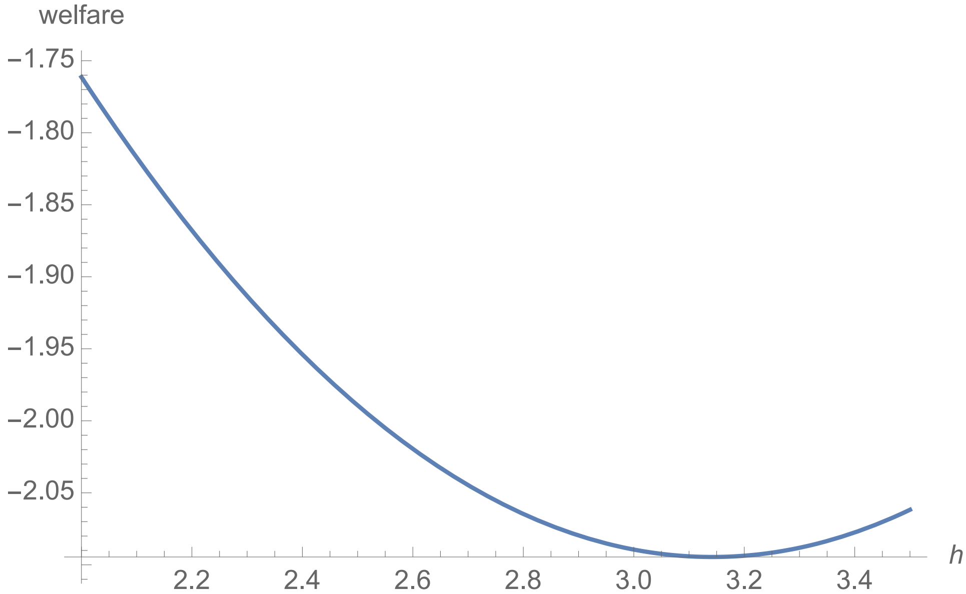

Figure 1: Non-monotonic relationship between h and W^* ($a = 2$, $e = 0.5$, $c = 1$, and $\alpha = 0.5$)

Indeed, it can be dependent on some policy choices. For example, nudges and other interventions can make people notice scams and other organized crimes. Additionally, the government can allocate the budget to protect consumers from organized crime. Such an investment by the government may reduce the marginal damage h of illegal activities. However, this result shows that it may also reduce the equilibrium social welfare (imagine a move from $h = 3.5$ to $h = 3.3$ in Figure 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.

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

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

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

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

Then, assuming that h is large enough 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, an increase in h reduces the mafias' activities though an increase in the equilibrium sanction. Indeed, $x^*(s^*)$ and

$y^*(s^*)$ approach zero as h increases. This implies that the strategic element, which is specified as exy in this example, becomes negligible and that the damages, hx^* and hy^*, drastically improve when h is large. Although an increase in h reduces the mafia's profit in equilibrium, a beneficial effect of the reduction of damage dominates the negative effect associated with the reduction of the mafia's profit. From another viewpoint, s^{**} becomes zero at $h = 0$. That is, s^* is the interior solution, but s^{**} is the corner solution when h is higher than 3 but lower than 3.5. Although s^* is smaller than s^{**} in this interval, these values become close if h is larger. This is because the mafia's activity level under s^{**} is zero. That is, the very severe punishment is optimal if $h > 3$. Notably, the U-shape is observed under such a situation. The equilibrium welfare becomes close to the welfare level under s^{**} if h is close to approximately 3.5.[9]

4 Extensions

This section offers an extension of the model in the previous section. Here, we consider a case where the two governments sequentially choose sanction levels. This corresponds to the situation where governments commit to their sanction levels and cannot change their policies by responding to other governments' choices. Indeed, it can be costly for governments to change policies; thus, this case is not unrealistic.

Specifically, we assume that the government in region 1 moves first and that the government in region 2 moves second; 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, and 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 in the maximization problem of the government in region 1, which takes the response of the government in region 2 into account. That is, the first-order condition is denoted as follows:

$$W^1_{s_1} = 0 \iff \alpha \underbrace{\Big[\pi^1_y \Big(\frac{\partial y^*}{\partial s_1} + \frac{\partial y^*}{\partial s_2} \frac{\partial \hat{s}_2}{\partial s_1} \Big) - x^* \Big]}_{\frac{\partial M^1}{\partial s_1}} - h \Big(\frac{\partial x^*}{\partial s_1} + \frac{\partial x^*}{\partial s_2} \frac{\partial \hat{s}_2}{\partial s_1} \Big) - g_{s_1} = 0 \tag{9}$$

Although it can be complicated to have intuitive results from this condition, we try to provide some implications. To derive the clear-cut result for the case with the sequential move, we

[9] See Supplemental Materials.

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 $W_{s_2 s_1}$.[10] Thus, comparative statics indicates that

$$W^2_{s_2 s_1} = \frac{\partial y^*}{\partial s_1}\Big(\alpha \pi^2_{xy} \frac{\partial x^*}{\partial s_2} - 1\Big). \tag{10}$$

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 $\frac{\partial \hat{s}_2}{\partial s_1} > 0$. On the other hand, 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 $\frac{\partial \hat{s}_2}{\partial s_1} < 0$.

Therefore, there are some different implications from the previous situations with simultaneous moves. In particular, we focus on implications for harm reductions. The main difference from (5) and (9) in terms of harm reduction is $h\Big(\frac{\partial x^*}{\partial s_2}\frac{\partial \hat{s}_2}{\partial s_1}\Big)$. Our results indicate that in both cases with "substitution" and "complementary" relations, we have $h\Big(\frac{\partial x^*}{\partial s_2}\frac{\partial \hat{s}_2}{\partial s_1}\Big) < 0$. Therefore, the government that moves first (i.e., government in region 1) has an incentive to make more effort to reduce social harm in sequential move games 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. On the other hand, 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 as the local government cares about the local mafia's profit, lax enforcement policies will be realized.

5 Concluding remarks

This paper examines how the interactions of governments yield coordination failures of sanctions in their territories when each government tries to control the activities of mafias in its territory. We found that collaborative relations between mafias lead to a kind of free-rider problem between local governments, while competitive relations between mafias lead to excessive pollution between local governments.

[10]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 $W_{s_1 s_1} < 0$.

Our analysis can be considered the first step for the development of a strategic approach to crackdown on organized crime. There can be a variety of directions in which we can extend our model. For instance, throughout this paper, we assume that there is only one crime organization in one region. However, in reality, there are multiple organizations that commit harmful activities. It may be the case that mafias in the same region are collaborative (complementary), while mafias in different regions are competitive (substitutive). This is a natural extension of our model. For another, one may consider the case where some mafias move first and the others follow the first movers. That is, there are leading mafias. This type of extension is also plausible. Such attempts remain for future research.

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Supplemental material

This section offers materials associated with the numerical results in Section 3.[11] We use the payoff functions specified in Section 4, and the parameters are fixed as follows: $a = 2$, $e = 0.5$, $c = 1$, and $\alpha = 0.5$. As mentioned in Section 3, we found a U-shaped relationship between W^* and h. This section presents s^* and s^{**} and the corresponding activity levels of each mafia. First, note that if h become high, then both the equilibrium sanction and the first-best sanction become high. See Figure 2. Since s^{**} is higher than s^*, as mentioned in Section 3 (note that we assume $e > 0$), the mafia's activity level under s^{**} reaches zero at a certain point ($h = 3$). Therefore, s^{**} becomes flat after $h = 3$. The relationship between equilibrium welfare under s^* and optimal welfare under s^{**} is shown in Figure 4.

The aforementioned example corresponds to the case of complementarity because $e = 0.5$. Now, we report the case of substitution. That is, the parameters are fixed as follows: $a = 2$, $e = -0.5$, $c = 1$, and $\alpha = 0.5$. Figures 5–7 show the sanctions, the mafias' illegal activities, and welfare levels. Only interior solutions are observed in this case.

[11] Mathematica, Version 12.0 (Wolfram Research, Inc. 2019) is used for obtaining Figures 2–7.

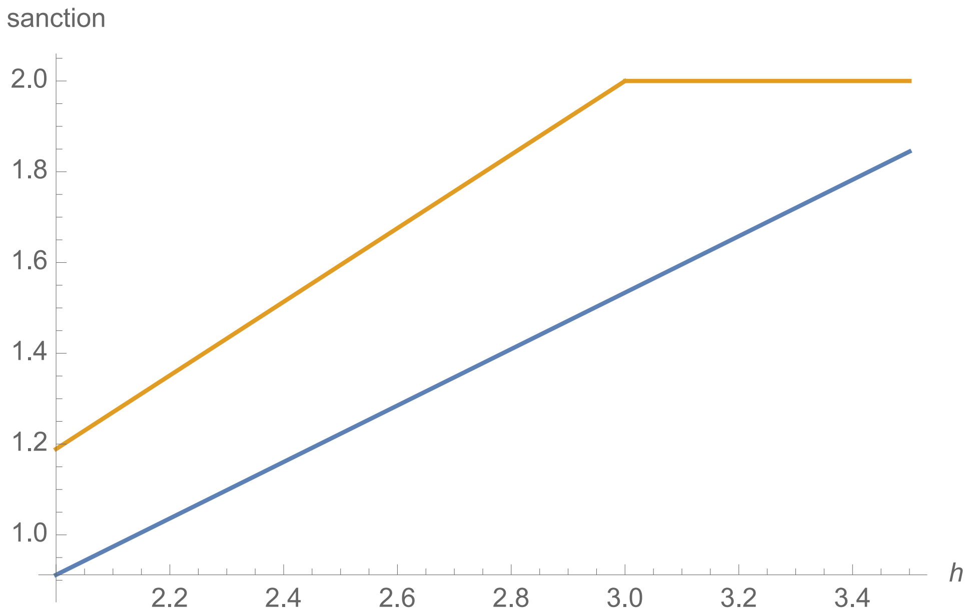

Figure 2: Changes in the equilibrium sanction s^* (blue) and first-best sanction s^{**} (orange) with regard to h ($a = 2$, $e = 0.5$, $c = 1$, and $\alpha = 0.5$)

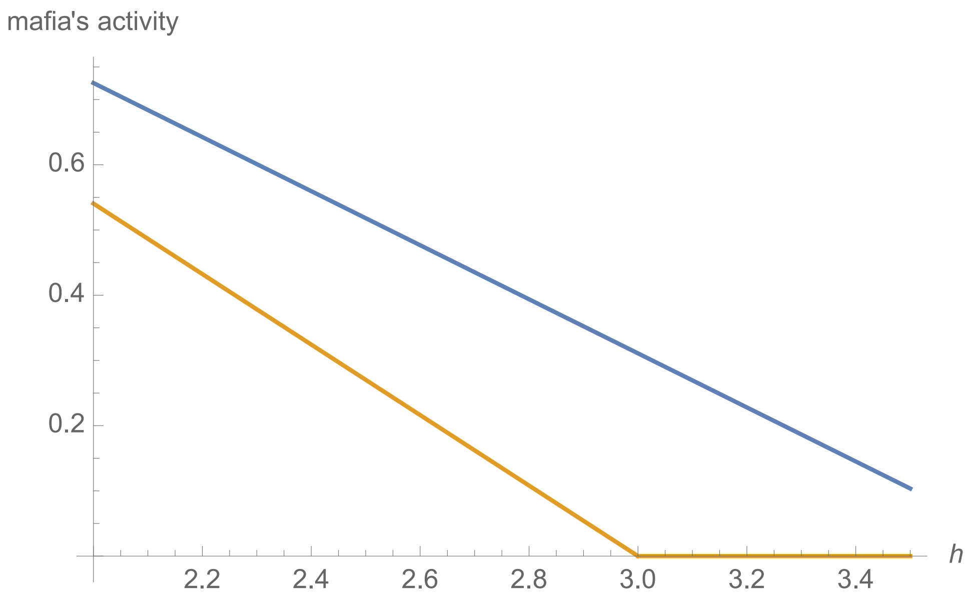

Figure 3: Changes in the equilibrium activities of each mafia $x^*(s^*)/y^*(s^*)$ (blue) and those under the first-best sanction $x^*(s^{**})/y^*(s^{**})$ (orange) with regard to h ($a = 2$, $e = 0.5$, $c = 1$, and $\alpha = 0.5$)

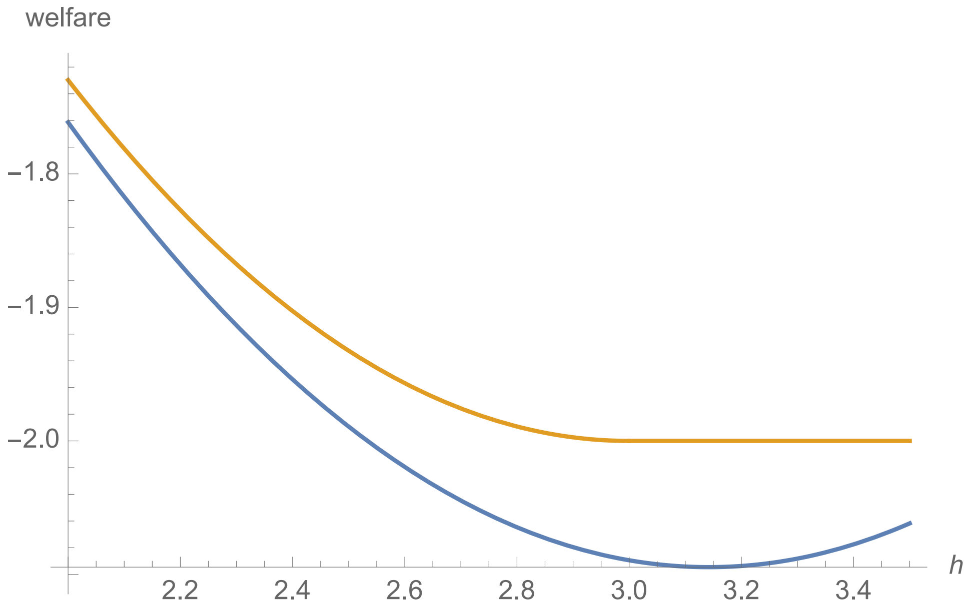

Figure 4: Changes in the equilibrium welfare $W^*(s^*)$ (blue) and one under the first-best sanction $W^*(s^{**})$ (orange) with regard to h ($a = 2$, $e = 0.5$, $c = 1$, and $\alpha = 0.5$)

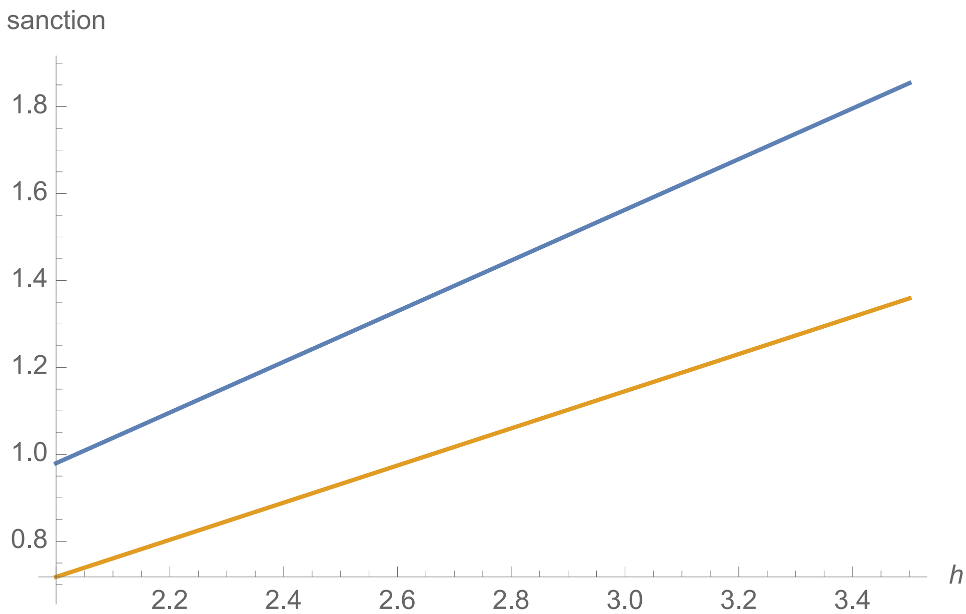

Figure 5: Changes in the equilibrium sanction s^* (blue) and first-best sanction s^{**} (orange) with regard to h ($a = 2$, $e = -0.5$, $c = 1$, and $\alpha = 0.5$)

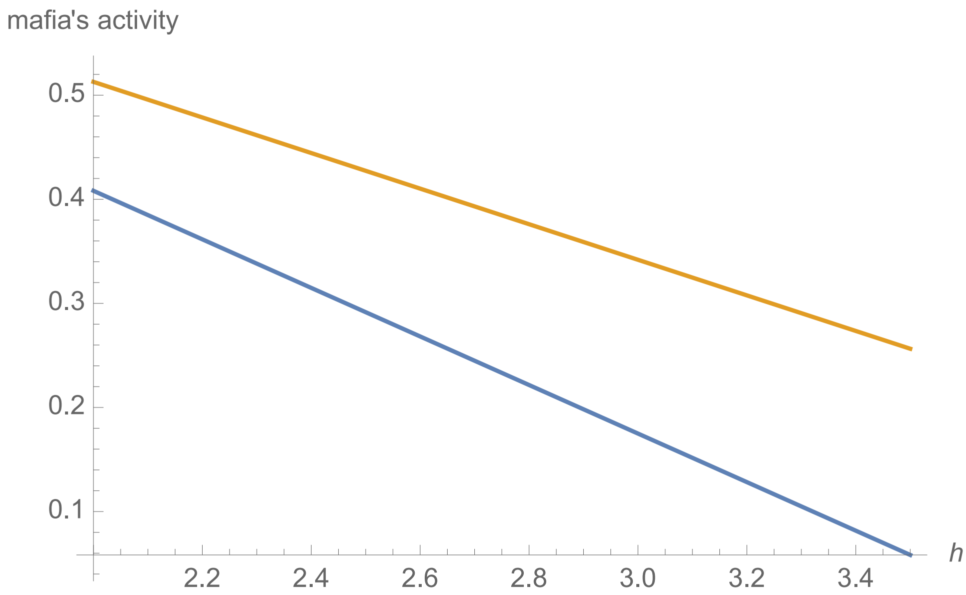

Figure 6: Changes in the equilibrium activities of each mafia $x^*(s^*)/y^*(s^*)$ (blue) and those under the first-best sanction $x^*(s^{**})/y^*(s^{**})$ (orange) with regard to h ($a = 2$, $e = -0.5$, $c = 1$, and $\alpha = 0.5$)

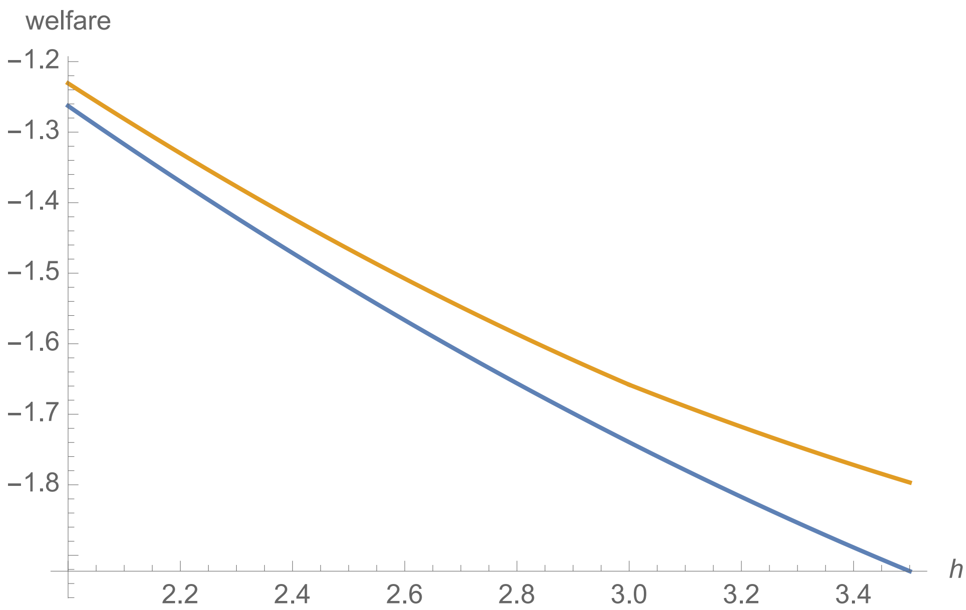

Figure 7: Changes in the equilibrium welfare $W^*(s^*)$ (blue) and one under the first-best sanction $W^*(s^{**})$ (orange) with regard to h ($a = 2$, $e = -0.5$, $c = 1$, and $\alpha = 0.5$)