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Organized crime as a link between inequality and corruption

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Abstract

We study a model that establishes a novel theoretical rationale for the empirically well-documented relation between inequality and corruption. According to our model, inequality can nurture corruption by empowering organized crime because collusion between local police forces and criminal organizations is more likely in societies characterized by high inequality or weak security forces. Law enforcement and organized crime have a strong incentive to collude due to efficiency gains from specialization. However, their agreement breaks down when the mobsters can no longer credibly commit to joint rent maximization and thus start to compete with law enforcement for citizens' wealth. The mobsters then non-violently monopolize the market for extortion by undercutting the police forces, similar to a strategy of predatory pricing. Criminal collusion is thus not very different from its corporate equivalent; hence, similar policy measures should be promising. In addition, our model also suggests that the criminal organization's higher efficiency in extracting rents has a greater impact when the relative power between law enforcement and organized crime is rather balanced. Accordingly, when violent conflict becomes less predictable, non-violent elements of relative power become more relevant. Our model also allows for the interpretation that in the absence of strong social norms against corruption, organized crime is more difficult to challenge.

Keywords Inequality · Corruption · Organized crime · Public security

JEL Classification C72 · D31 · D63 · D73 · H42 · K14 · K42

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1 Introduction

On October 17, 1931, during the peak of his reign, Alphonse "Al" Capone was found guilty of tax evasion and, one week later, sentenced to eleven years in prison. Beyond the well-known fact that Capone was finally brought down for tax evasion—rather than for the many murders he likely ordered—two other remarkable circumstances of his conviction are also worth noting. First, the investigations that finally led to the verdict were carried out mainly by federal law enforcement agencies, the local officialdom had been thoroughly corrupted by Capone's large-scale bribing (Richman & Stuntz, 2005). Second, Capone's conviction, marking the beginning of his power's decline, was prefaced by the beginnings of the Great Depression, which resulted in an economic downturn but also in a massive reduction of inequality (see Fig. 1). Even if it is impossible to determine whether this chronology is merely coincidental, it is worth noting that the decline of the American Mafia as a whole followed similar patterns.

As the American Mafia primarily provided protection for the (criminal) activities of others, its main asset was its large network of connections to urban political machines and the accompanying significant influence in local and city politics (Reuter, 1995; Skaperdas, 2001). After reaching the peak of its power and influence in the mid-1950s (Boyd, 2015), the Mafia became a victim of its own success, which had aroused interest in its activities. The problem of organized crime was subsequently placed on the political agenda and, since the beginning of 1961, the US federal government "had aggressively orchestrated a nationwide attack" on the Mafia (Calder, 2009, p. 18). This development culminated in President John F. Kennedy's "War on Organized Crime," announced in 1963. At the latest at that moment, the decline of the American Mafia began when its symbiosis with corrupt local law enforcement agencies and urban political machines started to dissolve. Reuter (1995) particularly emphasizes the involvement and improvement of federal law enforcement agencies as the main factors that pushed back the Mafia's influence. As a result of the intensified federal participation in local government financing and the new drive among federal agencies to make corruption cases, urban political machines disappeared, local corruption shrank and, hence, the foundation of the Mafia's success was eroded (Reuter, 1995). Yet again, this development coincided with a period of comparatively low inequality (see, again, Fig. 1).

Although both brief examples present only anecdotal evidence,[1] our main argument deserves some attention. As we will show in the next section, the economic literature provides a vast amount of empirical evidence to indicate that there likely exists a mutually reinforcing relationship between institutional quality, corruption, and inequality on one side and a positive effect of inequality on (organized) crime on the other. At the same time, there is no consensus in the literature on the causal effects for the emerging

[1] Battisti et al. (2020) has indeed found empirical evidence that inequality fosters the development of organized crime. There is also more anecdotal evidence in which the pattern mentioned above recurs. Focusing on the war on drugs in Mexico, Enamorado et al. (2016) show that Mexican municipalities with a higher inequality have a significantly higher homicide rate. Guatemala, one of the most unequal Latin American countries, also suffers from escalating levels of (organized) crime, corruption, and violence (International Crisis Group, 2011, 2016).

vicious circles and, despite the broad empirical evidence, there are surprisingly few theoretical models on these dynamics.

We are confident that we can shed some light on this relation from a theoretical perspective. Relying on our results, we offer a novel explanation for an interconnection from inequality to corruption/institutional quality via organized crime. According to our model, such a connection could emerge in areas characterized by the absence of the rule of law (i.e., weak protection of property rights) when a criminal organization fills this gap and cooperates with the security forces to exploit the local citizens. In our paper, the advantages of collusion emerge from asymmetric capabilities to extract funds from society. We assume that a criminal organization is generally better suited to monitor their victims' incomes than the Police and, hence, can extract more money from society. The police therefore have a strong incentive to team up with, and benefit from, the mob's greater efficiency. At the same time, the mob is willing to engage with the police because (i) the latter can impose additional costs on the criminal enterprise by simply doing its job and (ii) the police are willing to share some of the additional funds with the mob as compensation. This design may give an advantage to the criminal organization but, as our model shows, the players do not stick to the criminal alliance at all costs, eventually resulting in a breakdown of their agreement.

Our results suggest that inequality, as well as the distribution of power between the local police and the criminal organization, are the main determinants of their collusion's stability. Generally spoken, according to our model, more unequal societies with less powerful police forces are more likely to suffer from collusion between a criminal organization and the security forces. It is an interesting parallel to the examples from the beginning that, based on our interpretation of the model, a promising way of breaking out of this criminal collusion is *not* to strengthen the local police forces or to lower inequality but rather to intervene with external (central government or militarized) law enforcement agencies. This assessment partly results, as we are able to show, from the essential importance of social norms against corruption for challenging organized crime.

The remainder of this paper is organized as follows. Section 2 presents a brief summary of the relevant literature for the relation between inequality, corruption and institutional quality on one hand, and between inequality and (organized) crime on the other. In Sect. 3, we introduce our baseline model of a dysfunctional society suffering from widespread corruption and organized crime. Section 4 expands this model in order to analyze the conditions for stable collusion between law enforcement agencies and a criminal organization. In Sect. 5, we present the model's main results, whereas in Sect. 6, we discuss some implications for containing corruption and organized crime. Section 7 sums up and concludes.

2 Related literature

We analyze the relation of inequality, corruption, and the quality of institutions and their impact on (organized) crime. Due to the strong interest in the analysis of inequality and corruption, there already exists a large and steadily growing number of

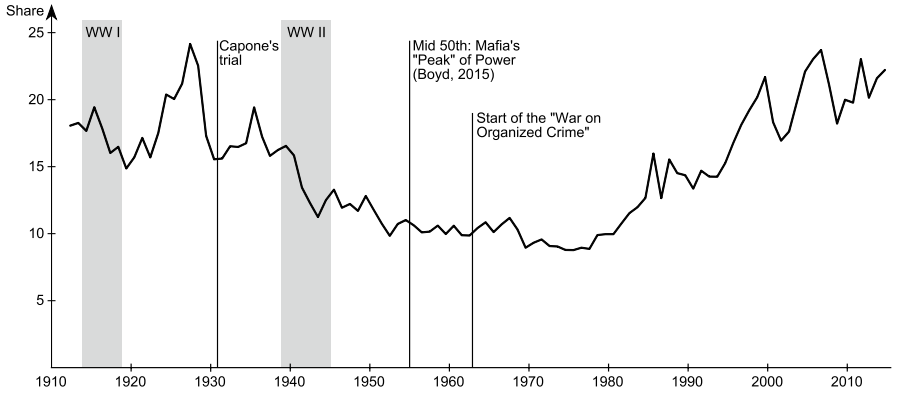

Fig. 1 Income Share of Top 1% of Total Income 1913–2015 for the USA (including capital gains) Source: Own illustration with data from Piketty and Saez (2007); series updated by the same authors

articles. Thus, it is beyond the scope of this section to provide a complete survey of the literature.

2.1 Inequality, corruption, and institutional quality

Regarding the relation of inequality and corruption, the empirical literature more or less agrees on a positive relationship with regional anomalies, but there is no consensus on the direction of the effect. Ades and di Tella (1997), Rothstein and Uslaner (2005), and Gyimah-Brempong and de Gyimah-Brempong (2006) suppose that corruption has an impact on inequality. In contrast, Jong-sung and Khagram (2005) and Glaeser and Saks (2006) assume that income inequality breeds corruption. Bringing together both views on the effect's direction, other authors see a more complex relationship between both factors. According to Chong and Gradstein (2007), Apergis et al. (2010), and Ariely and Uslaner (2016), the existence of large inequality fosters corruption but, at the same time, corruption also perpetuates inequality, thereby creating a vicious circle of mutually reinforcing inequality and corruption via different channels (e.g., social trust).

This clear picture becomes somewhat blurred when regional differences are considered. Dobson and Ramlogan-Dobson (2010, 2012) and Andres and Ramlogan-Dobson (2011) find evidence that there is a negative relation between income inequality and corruption in Latin American countries; they posit that these results stem from the large informal sector there. Wong (2016) instead explains these divergent consequences of corruption in Latin America as the result of the robust democratic institutions in these countries, where corruption often takes the form of vote-buying via governmental spending.

The formal theoretical modeling of the relation of inequality and corruption has received less attention. Relying on a framework that considers the relationship of entrepreneurs and (corrupt) bureaucrats, Dusha (2018, p. 14) concludes that "[s]ocieties with higher concentrations of wealth end up being more corrupt because inequality induces bureaucrats to charge lower bribes to the higher end of the wealth

distribution." Focusing on credit markets, Dutta and Mishra (2013, p. 607) show that (wealth) inequality may generate corruption if the former's existence prevents the selection of inefficient firms. Alesina and Angeletos (2005) link inequality to corruption via governmental redistribution.

Regarding the relationship of institutional quality and inequality, Easterly (2007) provides evidence that inequality predicts low-quality institutions. Chong and Gradstein (2007) suggest that there exists a double-causality relationship between both variables, in which the causality from inequality to institutions is dominant. In contrast, Carmignani (2009) identifies a negative influence of institutional quality on inequality, but they also find a positive impact of inequality on the implementation of redistributional policy (and thus on inequality) via threats to government's stability. Using a theoretical framework, Gradstein (2007) argues that democratization and the enforcement of property rights are more likely if the distribution of wealth is more equal and, at the same time, that increasing enforcement of property rights results in decreasing inequality. Relying on a similar framework, Sonin (2003) concludes that in societies with higher inequality, the optimal level of institutional quality (i.e., public security of property rights) would be lower.

Chong and Calderón (2000) find evidence that the relation between institutional quality and inequality is U-shaped, whereby it is positive for poor countries and negative for rich ones. Similar to the case of inequality and corruption, the authors attribute this pattern to the importance and size of the informal sectors in poor countries. However, Islam and Montenegro (2002) show that there is no relation between inequality and institutional quality once regional dummies for Latin America and Sub-Saharan Africa are introduced. In addition, according to Sokoloff and Engerman (2000), Engerman and Sokoloff (2002), or Chong and Gradstein (2007), there may be a feedback relationship between institutional quality and inequality, creating a vicious circle similar to that of inequality and corruption.

2.2 Inequality, (organized) crime and corruption

The economics of crime literature generally follows Becker's (1968) well-known paradigm that decisions to engage in crime are as rational as all other decisions. People thus become criminals if crime is expected to pay better than the labor market. Based on these considerations, inequality and poverty should have a positive effect on crime because they "make crime more profitable at a given level of crime deterrence" (Bourguignon, 2001, p. 182). The theoretical literature on crime and inequality focuses on that relationship. Using more sophisticated frameworks than Becker, authors such as Chiu and Madden (1998) or Imrohoroğlu et al. (2000) provide microfoundations for the explanation of aggregated crime rates. Both show theoretically that higher inequality should result in higher property crime.

Very few publications have examined the relation between organized crime and inequality, perhaps due to the difficulties in measuring organized crime. Here, Bernardo et al. (2020) identify the great relevance of the indices used for the results, when the impact and consequences of organized crime are empirically analyzed. For the case of Italy, Battisti et al. (2020) indeed found evidence that higher inequality

fosters the development of organized crime. Closely related, Bernardo et al. (2020) show that the presence of organized crime degrades local socio-economic conditions. At the same time, a broad economic literature on organized crime in general and its relation to corruption in particular exists.[2] The "United Nations Convention against Transnational Organized Crime (UNTOC)" defines an organized crime group in Art. 2 as a non-randomly formed group "of three or more persons, existing for a period of time and acting in concert with the aim of committing one or more serious crimes or offenses [...] in order to obtain, directly or indirectly, a financial or other material benefit" whereby a serious crime is a conduct that constitutes "an offence punishable by a maximum deprivation of liberty of at least four years or a more serious penalty." Schelling (1971), in a focus on the economic analysis of organized crime, defines its business as the monopolized extortion of (criminal) entrepreneurs. In exchange, the party being extorted receives protection against the mafia itself but also against other criminals and, if needed, against law enforcement (predominantly, by using corruption). Even if modern organized crime groups may have much broader fields of activity, corruption remains an integral part of organized crime and, generally, both are expected to have a positive relation. As one of the very few empirical works on this topic, Pinotti (2015a) indeed finds evidence that politicians are, on average, more corrupt in countries with higher levels of organized crime.

The theoretical analysis of corruption and organized crime receives more attention. Starting with Becker and Stigler (1974), corruption is expected to lower the costs of crime by reducing the risk of conviction. Bueno de Mesquita and Hafer (2008) have a focus similar to that of this paper, but they analyze corruption and collusion between organized crime and governments. They argue that the level of corruption depends on the mafia strength but also that, counterintuitively, stronger criminal organizations yield less corrupt governments. This conclusion appears to conflict with the results of this paper. However, these discrepancies result from differences in the modeling strategies and in the definitions of corruption.[3] Interestingly, Bueno de Mesquita and Hafer (2008) also show that collusion between the government and a criminal organization enables the latter to extort larger funds and that the mob's willingness to bribe is crucial for the government's reaction. Those results are in line with ours, but our analysis goes further. By incorporating the impact of inequality, we are able to show how the societal distribution of income affects the relative power between the criminal organization and law enforcement—and thus, the stability of collusion (and corruption). Furthermore, our results allow us to conclude that criminal collusion breaks down due to opportunistic behavior by the criminal organization, which is no longer able to credibly commit to joint extortion.

[2] Fiorentini and Peltzman (1996) provide a very good access to the topic.

[3] We analyze corruption as the payment of bribes to the police, whereas a corrupt government embezzles public funds in Bueno de Mesquita and Hafer (2008). For this reason, a weak criminal organization results in more corruption because the government must invest less in law enforcement, leaving more funds to embezzle.

Given the negative consequences of organized crime and corruption (e.g., Pinotti, 2015a; b), other literature focuses on the possible instruments to counter these challenges. Polinsky and Shavell (2001), for example, suggest rewards for uncovering bribery. However, more recent research suggests that traditional instruments of law enforcement (e.g., more policing) can be ineffective or even counterproductive if corruption and organized crime are not addressed together (e.g., Buscaglia, 2008; Kugler et al., 2005). To avoid (at least partially) those negative consequences of corruption on the efficiency of law enforcement, leniency programs can be used. Piccolo and Immordino (2017), theoretically analyzing optimal leniency, argue that such programs can *increase* the incentives for organized crime and access should thus be restricted. Gamba et al. (2018) theoretically linked those programs' efficiency to corruption and the level of law enforcement: If law enforcement is weak, a low level of corruption can enhance the efficiency of leniency programs, and *vice versa*.

For the relation of ordinary crime and inequality, a broad empirical literature exists. In an early paper, Ehrlich (1973) finds evidence that appears to confirm inequality's positive effect on peoples' willingness to participate in illegitimate activities regarding property. Since his pioneering work, these empirical results have been confirmed many times for different kinds of crime using cross-sectional and panel data from different countries or minor administrative units as well as for different measures of inequality (see, e.g., Bourguignon et al., 2003; Choe, 2008; Fajnzylber et al., 2002a; b; Kelly, 2000; Scorzafave and Soares, 2009). Only Chintrakarn and Herzer (2012) argue for the reverse relation. However, this relationship is not as clear as it may initially appear. Using time-series data instead of cross-sectional or panel data, Allen (1996), for example, finds no evidence for a link, whereas Brush (2007) even identifies a negative relation. Neumayer (2003, 2005) also finds no evidence and argues that the positive findings of other authors resulted from methodological shortcomings.

Our paper contributes to the existing literature in three ways. First, as mentioned before, we offer a novel explanation for a positive impact of inequality on corruption and organized crime. Second, we bridge the research on organized crime with the research on inequality, suggesting a positive relation from the latter to the former and, thus, a relation similar to that between inequality and ordinary crime. Third, we are able to show that the relative power of an organized crime group vis-a-vis the security forces affects the former's usage of its non-violent and violent capabilities. When the benefits of violent means of contest are less predictable, a criminal organization is better able to monetize its higher efficiency in extorting funds from society.

3 Baseline model of extortion

3.1 Organized crime, protection, and extortion

With the help of our model, we analyze a rather simple situation: For the sake of a more intuitive understanding, consider a small city in a peripheral region of a country. Due to external reasons such as geographic, ethnic, or social distance

(Skaperdas, 2001, p. 180), the central government has only a weak impact on local events and is not able to provide sufficient public security in the outlying areas. Such an environment likely has two effects in the periphery: (i) it fosters the abuse of public power by public employers for their own benefits (i.e., corruption) and (ii) the existing power vacuum could be filled by a criminal organization providing security, primarily against itself.

Such a situation and the related consequences can often be found in the real world.[4] The extortionist nature of organized crime is nonetheless not always apparent; this is particularly true for the Sicilian mafia, "the oldest and most notorious" criminal organization (Buonanno et al., 2015, p. F176), which emerged in an environment very similar to that described above.[5] Its antecedents began by providing private protection for (agricultural) landowners in areas with weak public protection of property rights but widespread banditry (e.g., Bandiera, 2003; Gambetta, 1996), highly valued natural resources or crops (Buonanno et al., 2015; Dimico et al., 2017), or strong socialist movements (Acemoglu et al., 2020). On this basis, Gambetta (1996) argues that the main activity of the Sicilian Mafia is still the mutually beneficial provision of protection for entrepreneurs, similar to insurance. However, he also argues that the Mafia (i) definitely needs a monopoly on protection; (ii) offers only long-term, hard-to-terminate "contracts"; (iii) must violently punish "free-riders" (i.e., those who do not pay for protection) to internalize the positive externalities; and (iv) can provide protection at more or less no cost due to its reputation. Under such circumstances, the line between protection and extortion becomes blurred, at best.[6]

Bandiera (2003, p. 220), in contrast, recognizes a transition of the Sicilian Mafia's "services" and remarks that it indeed "gained legitimacy through the enforcement services it provided to the upper classes and then exploited the power and violent reputation thus acquired to threaten others and extract rents via extortion." Dimico et al. (2017) substantiate this argument for the case of Sicilian citrus-fruit farmers and their relation to the local mafia. The latter "thrived from offering protection to lemon and orange producers, [...but the] protection services easily slipped into extortion where producers faced a direct threat of violence from the mafia" (Dimico et al., 2017, p. 1098). A similar view can be found at Konrad and Skaperdas (1998, p. 72). The authors do not rule out the emergence of criminal organizations that refrain from pure extortion and instead also protect citizens from third-party crime, but they argue that this kind of protection is "rather primitive and unpredictable and, without any checks to its coercive power, can easily revert [...] to extortion." Buonanno et al. (2015, p. F176) argue for a parallel emergence of both purposes (protection and extortion) in Sicily as the result of "a boom in the value of natural resources

[4] See, e.g., Oppenheimer (1996) for contemporary Mexico, Reuter (1995) for the United States at the beginning of the 20th century, Gambetta (1996) for Sicily, Handelman (1994), Frye and Zhuravskaya (2000) for Russia in the 1990s, or The Economist (2022) for several Special Economic Zones in Southeast Asia today. See also Skaperdas (2001) for a summary.

[5] We are very grateful to an anonymous referee who pointed us to the relevance of the Sicilian mafia's emergence for this paper.

[6] As Gambetta (1996, p. 57, emph. in original) summarizes, on this basis, "customers are [...] *internalized* [...and] become a permanent feature of the firm [i.e., the criminal organization], almost its *property*".

[..., which] creates both a demand for private protection and opportunities to extract rents through extortion." Due to those considerations, the view on organized crime as more or less pure extortionists who protect only against themselves, is widespread in the literature (e.g., also Bueno de Mesquita and Hafer, 2008; Pinotti, 2015b).

The existence of an extortionist criminal organization and only corrupt public agencies (e.g., polices forces, local politics, or public administration) creates a dilemma for the local citizens regarding their (public) security: they can either bribe local police forces or they can pay protection money to mobsters.[7] However, it is not so far-fetched to expect that the public actors (here, especially the police and prosecution) and the criminals may team up in such a situation, extort money from the citizens together, and share the loot. If this kind of collusion happens, the citizens can only choose between paying the mobsters and remaining unprotected.

The baseline model's aim is to explore the rationale of such collusion and the conditions under which collusion occurs. For the sake of a simple access, we assume that the bribes and the protection rackets, as well as the distribution of power between the mobsters and law enforcement, are exogenous in the baseline model. However, we will loosen these assumptions in the following extended model, showing how strategic extortion/bribing may affect the incentives for collusion.

3.2 Structure of the model

In our model, we consider a society with a large population of ex ante heterogeneous Citizens (C). The Citizens differ with respect to their income $G \in \mathbb{R}_0^+$ and, for simplification, their mass is normalized to one (seeTable 1 for a summary of the notation). Let $f(\cdot)$ denote the probability density function of income G in the population and $F(\cdot)$ the related cumulative distribution function.[8] In this regard, albeit in highly simplified terms, $F(\dot{G})$ and $F(\dot{G}) = 1 - F(\dot{G})$ can be interpreted as the numbers of people who earn less or more than income $\dot{G}$, respectively. In the following, we also need the cumulative distribution of total income in the population, denoted by $K(\cdot)$, for the analysis. Based on the distribution of income, we can calculate

$$K(\dot{G}) = \int_0^{\dot{G}} G\, dF(\cdot) = \int_0^{\dot{G}} f(G) \times G\, dG \tag{1}$$

as the total amount of income held by Citizens with an income of $\dot{G}$ or lower. For the sake of readability, we define

[7] In his seminal book on the Sicilian Mafia, Gambetta (1996, p. 164) demonstrates that this is a rather accurate description of reality, where "the police are seen as a competing supplier of protection." Similarly, Bueno de Mesquita and Hafer (2008, p. 2) state that victims of a mafia "have two choices: to pay off the mafia or to appeal to the government for protection".

[8] Where needed (e.g., for figures), we assume that income is log-normal distributed in the population. Relying on log-normal distributions to model the distribution of income is not without limitation, but it is widely used to analyze related topics in the literature. See Sect. 5 for a discussion where log-normal distributions are used to numerically evaluate the model.

$$K(\dot{G}) = \int_{\dot{G}}^{+\infty} G \; dF(\cdot) = \int_{\dot{G}}^{+\infty} f(G) \times G \; dG \tag{2}$$

as the corresponding complement, i.e., as the total amount of income held by Citizens with an income higher than $\dot{G}$. For completeness, we also define

$$K(\infty) = K(\dot{G}) + K(\dot{G}) = \int_{0}^{+\infty} f(G) \times G \; dG \tag{3}$$

as the society's total income and

$$\overline{K}(\dot{G}) = \frac{K(\dot{G})}{K(\infty)} = 1 - \frac{K(\dot{G})}{K(\infty)} = 1 - \overline{K}(\dot{G}) \tag{4}$$

as the share of $K(\dot{G})$ or $K(\dot{G})$, respectively, on society's total income. Figure 2 illustrates the distributions for different extents of inequality; for the case of log-normal distributed income, we can see that a society's inequality rises with an increasing standard deviation σ.

The society's public security is, furthermore, very dysfunctional. This is characterized by a powerful criminal organization (the "Mob"—*M*) as well as a corrupt (local) police force (the "Police"—*P*).[9] As argued before, we assume an asymmetric relationship between both actors (i.e. Mob and Police), which emerges from differing capabilities to extract rents (protection money or bribes) from the Citizens. The Police are only able to collect a lump-sum bribe $T \in \mathbb{R}_0^+$, whereas the Mob enforces an income-related extortion rate $s \in [0, 1]$. Accordingly, the Mob is more efficient (or, at least, has better knowledge of the Citizens' income) and is thus able to discriminate between Citizens—and hence, to extract individual protection rates.

Those differences indeed find their examples in the real world. By using legitimate business relations, criminal organizations are better able to monitor their victims than the Police. Gambetta (1996), for example, cites several examples of entrepreneurs being forced to accept mobsters as official shareholders of their companies. Furthermore, establishing official down-stream relations allows mobsters to sell overpriced (legal) goods (Dick, 1995) and, simultaneously, impede opportunistic behavior by the victims of extortion. Instead of measuring a victim's income, the criminal organization now must ensure only that they remain the sole business partner, or they may even delegate monitoring by forcing their victims into business relations with other "partners," whereby these contracts rely on artificially high or low prices.[10] Those relations and inside views easily allow the mafia to discriminate the payments of their victims of extortion, whereby "its price varies according to the customers' wealth and position, the types of services required, and last but not least the whims of the seller" (Gambetta, 1996, p. 7). Alexander (1997) as well as Balletta

[9] The latter also incorporates all other local public actors who could negatively affect the Mob's extortion (e.g., prosecution, courts, politics, or public administration). Because the police should be the most important actor for public security, we decided to name the player "Police".

[10] For example, Gambetta (1996) states that the Sicilian Mafia's victims often regularly have the choice of paying protection money in cash or accepting a compulsory list of customers, contractors, or suppliers.

and Lavezzi (2019) present empirical evidence for regressive price discrimination of the mafias in Prohibition-era Chicago or contemporary Sicily, respectively.

Police forces regularly lack the opportunities to establish such official relations. Accordingly, it should be more expensive for them to monitor their potential victims, and, hence, they should be more willing to accept less-costly lump-sum bribes. Furthermore, the very nature of the payments should also partly explain those differences. Whereas most Citizens infrequently pay bribes to a particular (public-employed) recipient and most such bribes are paid for an actual transaction (i.e., for receiving a service), protection money is usually paid to a criminal organization on a regular basis and independent from a special occasion (i.e., it is paid for not being harmed for the next period). Hence, due to the infrequent contact in the former case, an official should be less willing to invest money for investigating a citizen's income and, again, rely on lump-sum payments in the former case.[11]

A citizen's security is affected by their decision to pay either the Mob or the Police. Because the Police must secure the Citizens' property against the Mob, public security can only be imperfect.[12] Here, $\omega \in [0, 1]$ is the Mob's (exogenous) probability of being able to capture a citizen's income against the Police's protection. For example, we can imagine that the Mob is able to bypass the Police's protection and appropriate the citizen's income; ω would then represent the distribution of power between both actors. At the same time, extortion (and bribing) is without costs because neither the Mob nor the Police have to expect resistance by the Citizens. This interesting characteristic of extortion by an organized crime group has been discussed by Gambetta (1996). Organized crime groups rely heavily on their reputation *to be generally able* to violently crush on all opposition. As a result, resistance is very rare because no one dares to challenge the mobsters, and extortion is possible only due to the *threat of* violence. The Police's ability to collect bribes also rests upon their reputation to be generally able to protect a citizen against the Mob, and they are also able to misuse public funds to provide their service. Accordingly, the costs of "service" should be negligible for both.

Taking all those considerations together, the expected payoff of a citizen with income $\dot{G}$ is

$$\pi_C^T = (1 - \omega)\dot{G} - T \tag{5}$$

if they bribe the Police. In the other case, if the citizen pays protection money to the Mob, their income would instead be perfectly secured. Now, a citizen with income $\dot{G}$, paying the income-related extortion rate s, has the payoff

$$\pi_C^S = (1 - s)\dot{G}. \tag{6}$$

However, public security is not always available. If the Mob and the Police agree to cooperate, the Police refuse all bribes from Citizens and no public security is

[11] Our assumption is in line with the literature, as well, in which bribes are often modeled as lump-sum payments (see, e.g. Besley and McLaren, 1993; Bowles and Garoupa, 1997; Bardhan, 2006).

[12] A similar design of a protection racket can be found in Bueno de Mesquita and Hafer (2008).

Table 1 Notation

Variable	Description
C, P, M	Players (citizen(s), police, Mob)
$\dot{G}$	A citizen's income
$\overline{G}$	Income threshold
s	Rate for protection money paid by C to M
T	Bribe for P by C
B	Bribe to P by M
$\overline{B}, \underline{B}$	Maximum/minimum bribe B
R	Rent from collusion between P and M
$F(\cdot)$	Cumulative distribution of G
$K(\cdot)$	Cumulative distribution of total income
ω	Distribution of power between M and P in contest
π_i^j	Payoff of player i given payment j

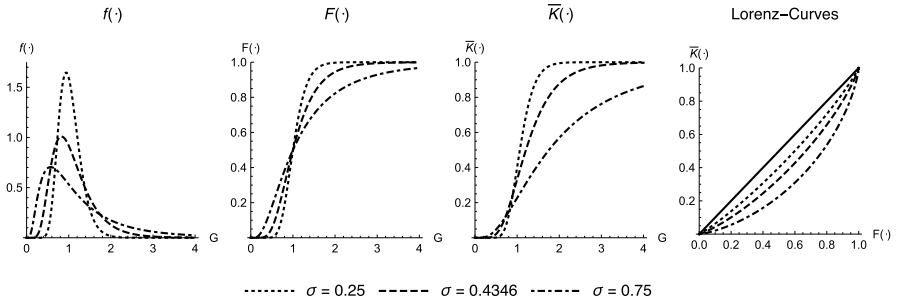

Fig. 2 Graphs for the distributions $f(\cdot)$, $F(\cdot)$, and $\overline{K}(\cdot)$. Income $\dot{G}$ assumed to be lognormal distributed with standard deviation σ and mean $\mu = 0$

provided (i.e., $\omega = 1$). This occurs and, thus, both actors collude when the Mob offers a bribe $B \in \mathbb{R}^+$ and, of course, if the Police accept this bribe.

Lemma 1 *The Citizens* (*i*) *never choose to pay neither protection money to the Mob nor bribes to the Police and* (*ii*) *always pay the Mob if the Police refuse their bribes. Accordingly, if the Police accept the Citizens' bribes, the Citizens either pay the Mob or bribe the Police.*

Proof See Appendix A.1. □

Those considerations are summarized in the Game Tree in Fig. 3. The game starts with the Mob deciding to offer a bribe to the Police or not. If the Mob does not offer a bribe, the Citizens must choose whom to pay based on which kind of security they prefer. In the other case, if the Mob decides to offer a bribe to the Police, the Police must decide whether they accept or refuse the bribe. In case of refusal, the Citizens,

again, must decide whom to pay. However, if the Police accept the Mob's bribes, then all of the Citizens pay the Mob. We solve this game using backward induction, starting with the Citizens' decision as to whom they will pay. For simplicity, we assume first that s, T, and B are all exogenous, but we will loosen this assumption in the extended model in the next section.

3.3 Obtaining security...

A citizen with income $\dot{G}$ takes the parameters ω, s, B, and T and the behavior of all other Citizens as given and pays protection money if

$$\pi_C^S = (1-s)\dot{G} \geq (1-\omega)\dot{G} - T = \pi_C^T \tag{7}$$

holds true. Otherwise, the citizen bribes the Police. Equation (7) yields that all Citizens decide to pay protection money for $s \leq \omega$.[13] This result allows for a quite interesting interpretation. Given the "voluntary" nature of the Citizens' payment to the Mob and the then corruption-free Police, the society would appear to be peaceful. However, the ostensible absence of violent organized crime and corruption does *not* result from the provision of public security or from the enforcement of the Citizens' property rights. In fact, the Citizens are not harassed because they compensate the Mob for not plundering them. Put differently, the Citizens pay the Mob for respecting their property rights, and they are willing to pay that compensation because this payment is lower than the expected opportunity costs of enforcing their property rights.

In the opposite case, for $s > \omega$, some Citizens are willing to pay for the enforcement of their property rights. Now, a threshold $\overline{G}$ exists and only Citizens with an income

$$G \leq \overline{G} \equiv \frac{T}{s-\omega} \tag{8}$$

pay the Mob. All other Citizens bribe the Police, who attempt to protect the Citizens' property. It is worth noting that the criminal organization extorts protection money from the less affluent because only Citizens with a higher income can afford public security, turning the latter into a kind of club good. This situation can easily be applied to numerous countries where many citizens (especially the poor) lack basic public goods, such as public security, and where wealthier citizens must pay for private security (e.g., gated communities) in order to protect themselves and their families.

[13] For details, see the Proof of Lemma 2 in Appendix A.2.

3.4 ...and Eliminating security

The Citizens' decision regarding whom to pay, in turn, affects the Police's previous decision regarding whether to accept the Mob's bribe. We assume that the Police obtain a payoff

$$\pi_P^B = B \tag{9}$$

if they accept the Mob's bribe. Otherwise, when the Police refuse the bribe B and instead receive a bribe T from every citizen with an income higher than $\overline{G}$, their payoff is

$$\pi_P^T = \left[1 - F(\overline{G})\right] T = F(\underline{G})\, T. \tag{10}$$

The Police accept the Mob's bribe when $\pi_P^B \geq \pi_P^T$. This yields the threshold

$$B \geq \underline{B} \equiv F(\underline{G})\, T \tag{11}$$

that is the minimum bribe, which must be paid by the Mob in order to prevent the provision of public security.

The Mob's decision to offer a bribe to the Police depends not only on the behavior of the Police but also on the Citizens' subsequent decisions, particularly their willingness to pay bribes and protection money.

Lemma 2 *For $\omega \geq s$, the Mob does not offer a bribe to the Police because all Citizens pay the Mob irrespective of the Police's price for security.*

Proof See Appendix A.2. □

As Lemma 2 reveals, the Citizens are not willing to bribe the Police when they expect to lose more in a conflict with the Mob than they must pay to the Mob to avoid their harassment. Accordingly, the Police have no bargaining power regarding a bribe from the Mob.

The situation changes if at least some Citizens are willing to bribe the Police. For $s > \omega$, the Mob has two options: (i) Colluding with the Police, paying bribe B and being able to collect protection money from all Citizens without resistance; or (ii) competing with the Police, collecting protection money from some Citizens, and trying to overcome the Police's resistance in order to appropriate the income of the remainder. In the former case, all Citizens (must) pay a share of s of their income as protection money and the Mob thus generates the payoff

$$\pi_M^B = s\, K(\infty) - B \tag{12}$$

only reduced by the Police's bribe B. When, instead, the Mob and the Police compete, the decision is affected by the distribution of income in society and by the income threshold $\overline{G}$. The Mob's expected payoff then is

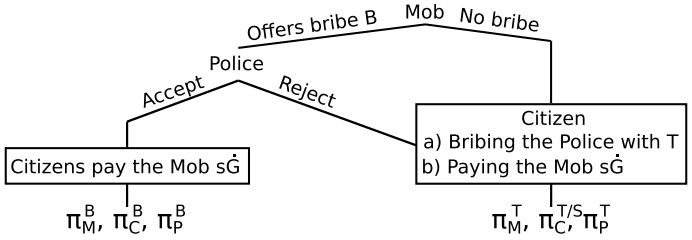

Fig. 3 Game tree of the baseline model

$$\pi_M^T = s\ K(\overline{G}) + \omega\ K(\underline{G}) \tag{13}$$

as all Citizens with an income smaller than $\overline{G}$ pay protection money and the Mob appropriates the other Citizens' income with probability ω. Here, the Mob bribes the Police when $\pi_M^B \geq \pi_M^T$ holds true. Upon substituting Eqs. (12) and (13), this yields

$$B \leq \overline{B} \equiv (s - \omega)K(\underline{G}) \tag{14}$$

for the maximum bribe that the Mob is willing to pay. Accordingly, the Mob would offer bribe B to the Police (and, of course, the Police would accept) if $\overline{B} \geq B \geq \underline{B}$ holds true.

Proposition 1 *For $s > \omega$, $\overline{B} > \underline{B}$ always holds true.*

Proof See Appendix A.3. □

Proposition 1 reveals a very interesting result: Under these (admittedly very narrow) circumstances, collusion between the Mob and the Police always creates a positive rent $R = \overline{B} - \underline{B}$ from cooperation. Accordingly, collusion is always beneficial for both as long as they can agree on a bribe $\dot{B} \in \left[\underline{B}, \overline{B}\right]$. Given this very low bar for cooperation, collusion should typically emerge in our baseline model and, due to its simplicity,[14] we will refrain from studying such a negotiation here; however, a mechanism for splitting the rent will be introduced in the next section. At this point, it is sufficient to recognize two results: First, our model's dysfunctional society always runs the risk of being captured by a criminal organization. If both actors are able to agree on a compensation for cooperation, collusion is then always beneficial. Second, differences in the efficiency of rent collection creates incentives for both actors to specialize and, thus, to jointly monopolize extortion in society. However, this gloomy outlook should not distract from a very important assumption of the baseline model. Both actors' ability to collude hinges on their ability to eliminate rent-seeking competition between themselves. As we will show in the following, the actors' strategic considerations about their collusive rent-seeking paves the way for

[14] Already very simple approaches like dictator or ultimatum games would always result in agreements on rent sharing.

opportunistic behavior, which ultimately prevents successful collusion. If at least one actor has incentives to overplay their hand, the other could refrain from cooperation, resulting in a fierce competition for bribes and protection money.

The purpose of the remainder of this paper is twofold: First, in the next section, we modify the game and assume that the Mob and the Police must reach an agreement on the division of the rent R and, thus, on the bribe B. Second, we will loosen the assumption that the bribe T as well as the extortion rate s are exogenous and study the actors' strategic options.

4 Model of strategic extortion and collusion

In this section, we analyze how the situation changes when the Police and the Mob gain some discretion on their decisions regarding extortion, bribes, and collusion. This extension needs a (new) mechanism for sharing the rent R between the Mob and the Police. In the baseline model, the Mob proposes the bribe and the Police can only accept or reject this offer. This situation resembles the well-known ultimatum game, in which the proposer can appropriate almost the entire rent, given rational players.[15] Instead of such a simple, but overly unrealistic approach, we utilize a two-level model of negotiations in the following, in which both actors can sanction "unfair" offers. Those negotiations took place after both players set s and T at the beginning of the game. In the first round, both players claim their respective shares (θ_M and θ_P) of the rent. The negotiations fail when at least one of the parties punches above its weight and thus $\theta_M + \theta_P > 1$ holds true. In that case, both compete for bribes and protection money in the next step and thus generate the payoffs without collusion π_i^T (with $i = M, P$). An agreement specifying the bribe

$$B = \underline{B} + \theta_P R = \overline{B} - \theta_M R \quad \text{with} \quad \theta_M = 1 - \theta_P \tag{15}$$

is instead reached when $\theta_M + \theta_P \leq 1$. The Police then refrain from enforcing public security and the Mob thus collects protection money without a rival, forcing all Citizens to pay. At the second stage, both players can contest their agreement by defecting from it, or they can decide to comply. When both comply, the Mob pays the agreed-upon bribe to the Police and the game ends. The players' payoffs can thus be written as

$$\pi_M^C = \pi_M^T + \theta_M R \quad \text{and} \quad \pi_P^C = \pi_P^T + \theta_P R \tag{16}$$

[15] From a purely game-theoretic perspective, a rational Mob would offer a bribe of $\underline{B} + \epsilon$ with $\epsilon \to 0$ and thus a share of the negotiation range only slightly higher than zero. Rational Police would nonetheless accept this offer because its rejection would prevent the creation of the surplus and thus result in no share at all. If, instead, the Police could make the offer, they would demand the bribe $\overline{B} - \epsilon$ with $\epsilon \to 0$, which the Mob would be willing to accept. However, experimental evidence suggests that many "proposers" offer non-trivial amounts of money and that many "responders" reject offers considered unfair in such situations (see, e.g., Gueth et al., 1982).

by substituting (15) in (12) and (9), respectively. If, however, at least one decides to defect, the agreement is void and there is a contest for R. During this contest, both players compete for R, whereby their chances to prevail are determined by the distribution of power ω and, for in the interest of simplicity, competition is costless.[16] After the contest, the game ends and, given risk-neutrality, the actors' expected payoffs are

$$\pi_M^F = \pi_M^T + \omega R \quad \text{and} \quad \pi_P^F = \pi_P^T + (1-\omega)R. \tag{17}$$

The game's structure is also specified in Fig. 4. We solve this game using backwards induction, starting with the decisions in the negotiations on the distribution of the rent.

4.1 Dividing the loot

Given the structure of the game, the Mob has to anticipate whether its offer would be rejected and whether the Police could defect in order to make an optimal offer.

Proposition 2 *There are two situations*:

1. *There is never an agreement for* $s \leq \omega$ *and, thus,* $\theta_M = \theta_P = 0$.
2. *Both players are always able to conclude an agreement on rent sharing for* $s > \omega$, *implying* $R > 0$. *The only subgame-perfect Nash-equilibrium offers for splitting the rent* R *are then* $\theta_M = \omega$ *and* $\theta_P = 1 - \omega$.

Proof See Appendix A.4. □

Proposition 2 reveals two interesting insights: First, both players are always able to reach a stable agreement *if they have something to share* (i.e., $R > 0$). Then, second, they split R according to the underlying distribution of power (ω).[17] In that case, the Mob realizes a payoff amounting to

$$\pi_M^C = \pi_M^T + \omega R = \pi_M^T + \omega\left(\overline{B} - \underline{B}\right) \tag{18}$$

and the Police's payoff is

$$\pi_P^C = \pi_P^T + (1-\omega)R = \pi_P^T + (1-\omega)\left(\overline{B} - \underline{B}\right). \tag{19}$$

[16] It will become clear from the Proof of Proposition 2 that even a costly contest should not significantly change the negotiations.

[17] This is in line with the literature of conflict economics, according to which the risk of conflict is small when the distribution of rents reflects the distribution of power and demands in negotiations are thus aligned to the parties' relative powers (Powell, 1996, 1999; Werner, 1999).

Figure 5 illustrates those payoffs for different distributions of income, showing that the inequality of the distribution significantly affects the optimal strategies of the players—or, at least, for the Mob. As we will show in the following section, those considerations have significant impact on the likelihood of successful collusion between the Mob and the Police.

4.2 Decisions on extortion rate and bribe

Based on the previous section's results, collusion between the Mob and the Police requires only the potential existence of a positive rent from collusion (i.e., $R > 0$). Because the latter is true for $s > \omega$ (see Proposition 2), reaching this condition should be very easy. However, in the following we will show that the players' strategic considerations regarding the maximization of their share of the rent could prevent them from reaching an agreement. Without an agreement, both players must compete for the Citizens' income.

Proposition 3 *There are two stable equilibria*:

1. *A collusive equilibrium consisting of a stable criminal agreement at which*

$$\begin{aligned} s^* = 1 \quad &\text{and} \quad T = T^* \\ &\text{with} \quad \forall\, T : \pi_P^C(s^*, T^*) \geq \pi_P^C(s^*, T) \\ &\text{when} \quad \forall\, s \geq \omega : \pi_M^C(s = 1, T^*) > \pi_M^C(s, T^*) \end{aligned} \tag{20}$$

2. *A competitive equilibrium without a criminal agreement at which*

$$\begin{aligned} s^* = \omega \quad &\text{and} \quad T = 0 \\ &\text{for} \quad \pi_M^C(s = 1, T^*) < \pi_M^C\left(s^L, T^*\right) \quad \forall\, s^L \in]\omega, 1[\\ &\text{with} \quad \pi_M^C\left(s_L, T^*\right) \geq \pi_M^C(s, T^*) \quad \forall\, s \in]\omega, 1\big), \exists\, \epsilon > 0 \\ &\quad \text{with} \quad |s - s_L| < \epsilon \end{aligned} \tag{21}$$

Proof See Appendix A.5. □

Proposition 3 reveals our model's core results: When both actors must assume that an agreement is not possible, the Mob then always outbids the Police (e.g., demands a rate for protection money at which no citizen would bribe the Police). In other words, the absence of collusion results in the *non-violent monopolization* of the market by the Mob as the latter applies a strategy similar to predatory pricing. Accordingly, the Police receive no bribes from either the Mob or the Citizens because there is no demand for law enforcement due to a lack of willingness to pay for public security. Thus, organized crime does not come to light and instead exists only beneath the surface, although it still extracts significant funds from society.

Hence, there is still demand (and willingness to pay) for non-corruptible public security-but there is no supply of it. Based on these considerations, we can now derive the players' payoffs by substituting the results from Proposition 3 in Eqs. (6), (9), and (12) and simplifying further.

Result 1 *There are two different situations*:

1. *In case of criminal collusion*:

$$\begin{aligned} &\pi_M = K(\infty) - \overline{B} + \omega R \quad \pi_P = \overline{B} - \omega R \quad \Pi_C = \sum \pi_C = 0 \\ &\text{with} \quad s = 1, \quad T = T^* > 0, \quad B = \overline{B} - \omega R \end{aligned} \tag{22}$$

2. *In case of criminal competition*:

$$\begin{aligned} &\pi_M = \omega K(\infty) \quad \pi_P = 0 \quad \Pi_C = \sum \pi_C = (1-\omega)K(\infty) \\ &\text{with} \quad s = \omega, \quad T = 0, \quad B = 0 \end{aligned} \tag{23}$$

Proposition 3 also reveals that collusion between the Mob and the Police is a tipping-point phenomenon. As illustrated by the middle graph of Fig. 5, a small change can trigger a breakdown of the criminal agreement, thereby significantly altering the players' strategies and, in turn, having large consequences for their payoffs. More concisely, a gradual reduction of $\pi_M^C(s = 1, T^*)$ to a value below $\pi_M^C(s_L, T^*)$ would result in a reduction of $s = 1$ to $s = s_L$. As a consequence, a race-to-the-bottom is triggered for s and T, ultimately resulting in a breakdown of the collusion. In short, instability of the corner solution $s = 1$ triggers the breakdown of collusion. This invites a very interesting interpretation: Clearly, the Mob's ability to credibly commit to enforcing the rent-maximizing extortion rate $s = 1$ is crucial for an agreement. In other words, in order to secure collusion, the Mob must be able to stop itself from strategically reducing s in order to strategically affect the negotiations *via* the threat points $(\pi_i^T, i = M, P)$. In this regard, criminal collusion is thus not very different from corporate collusion; both are stable only if the actors are able to bar themselves from opportunism and stop competing for "customers." In the next sections, we will further analyze the sources and consequences of these relations by computing the equilibria, while also highlighting some possible policy implications.

5 Results

In the previous section, we showed that in our model, collusion between the Mob and the Police (i.e., the existence of corruption) is a tipping-point phenomenon in which gradual changes can have large consequences. In order to shed more light on the causes for—and consequences of—those changes, we will now compute

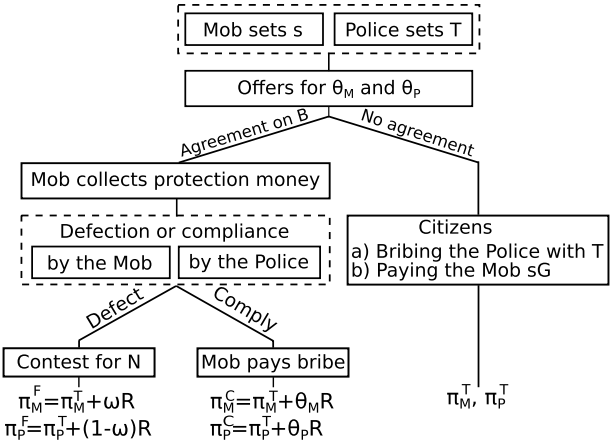

Fig. 4 Modified game tree. Dashed boxes represent information sets. Solid boxes are decision nodes

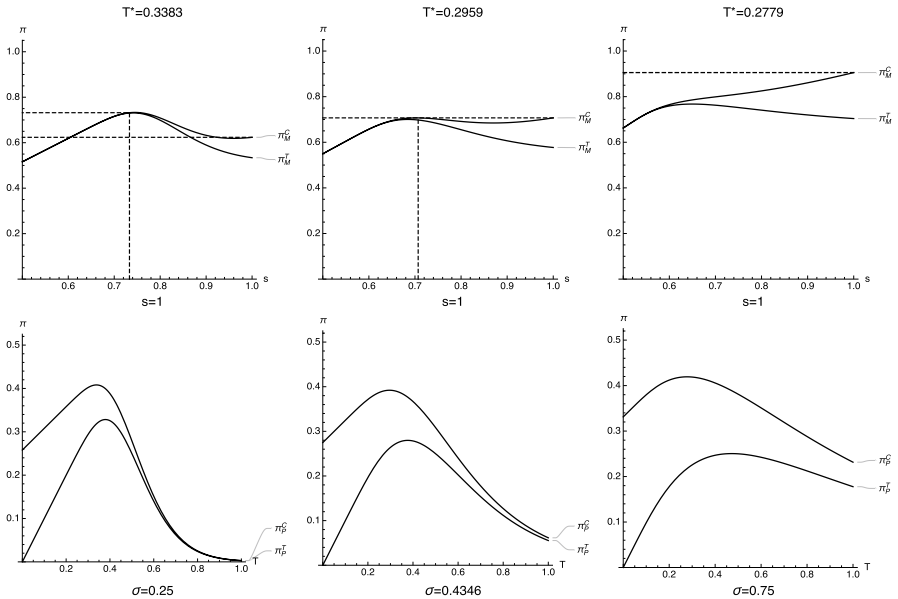

Fig. 5 Mob's (above) and Police's (below) payoffs for different income distributions (with $\omega = 0.5$). Log-normal distributions used for $F(\cdot)$ with standard deviation σ and mean $\mu = 0$. Inequality increases with increasing σ

the equilibria to identify the underlying mechanisms and the societal costs.[18] For these purposes, we utilize log-normal distributions for the Citizens' incomes; such

[18] The code for the computations can be requested from the author.

distributions are widely used for the analysis of similar topics.[19] Although relying on log-normal distributions to model income distributions is nonetheless slightly controversial (e.g., Lambert, 2011; Neal and Rosen, 2000), this class of distributions offers some convenient analytical properties (e.g., Cowell, 2011, p. 78ff.) and has definite empirical support (e.g., Cowell, 2000; 2011; Harrison, 1981; Lydall, 1968). Accordingly, the utilization of log-normal distributions appears to be the best fit, particularly given our focus on smaller incomes. Due to the utilization of log-normal distributions and the endogenization of s and T, the model's only remaining exogenous parameters are the relative power between the Police and the Mob ω and the proxy for the distribution of income σ.[20] As we will show in the following, both parameters also affect the distribution of rents between the players; thus, their impact should also be analyzed from the perspective of welfare economics.

At the same time, the utilization of log-normal distributions has some consequences for the interpretation of the results, which must be taken into account. When relying on log-normal distributions, a larger (smaller) σ—the underlying normal distribution's standard deviation—accounts for greater (lesser) inequality in society. However, this shift results from a more intricate change in the society's composition. A smaller σ comes with relatively more people who earn/own the log-distribution's mean e^{μ}, but fewer people who are extremely rich or poor, and vice versa (see, e.g., Fig. 2). In other words, the relatively poor people are then becoming both more numerous and richer. Accordingly, a smaller (larger) standard deviation σ of the distribution may be associated with greater (lesser) inequality in society but also with a smaller (larger) total wealth $K(\infty)$.

In order to take the latter effect into account, we rely not on the actors' absolute payoffs π_i in the following, but rather on their share of society's total wealth

$$\overline{\pi_i} = \frac{\pi_i}{K(\infty)} \quad \text{with} \quad \sum_i \overline{\pi_i} = 1 \quad \text{and} \quad i = M, P, C. \tag{24}$$

This is nonetheless a very good proxy for their payoffs because it illustrates the players' ability to appropriate societal rents and, thus, allows us to analyze the distributional effects of the Mob's strategies. To further illustrate the distributional consequences of collusion, we will also analyze the Mob's and the Police's abilities to secure a share of the rents that is disproportionately larger (smaller) than their relative power

$$\pi_M^S = \overline{\pi_M} - \omega \quad \text{or} \quad \pi_P^S = \overline{\pi_P} - (1 - \omega). \tag{25}$$

[19] See, e.g., Imrohoroğlu et al. (2000) for the analysis of crime or Bourguignon (2003), Kalwij and Verschoor (2007a, 2007b) for the analysis of growth and poverty, or Bramley and Smart (1996), who model the distribution of income in the UK.

[20] There is no income effect, i.e., proportional changes of the income have no distortive effect on the distribution of rents. This is illustrated by the only scaling effect of the distribution's mean μ on the players' payoffs, which also results in no distortions. Due to this lack of relevance, we will set $\mu = 0$ in the following, without any loss of generality.

Here, these relative powers account for (i) the most stable (hypothetical) rent-sharing agreement between both players when all rents would be at stake[21] and (ii) the Mob's secure share of the rents (i.e., which never triggers the involvement of the Police). From the perspective of the Mob, π_M^S can also be considered as its share of the profit, which is not related to its violent capacity but rather to the monetization of its relative advantage in extortion (i.e., its higher efficiency).

Based on these considerations, we can now further analyze the stability of collusion by identifying the tipping points between stable and unstable collusion. Here, corruption exists only when collusion is stable, because no one would pay bribes to the Police otherwise. As shown by Fig. 6, inequality (i.e., σ) and the relative violent capabilities (i.e., ω) have a negative relation. In other words, more unequal societies, or more powerful criminal organizations, ceteris paribus, increase the likelihood of stable criminal collusion and thus of the existence of corruption. This can be easily explained: Both effects are beneficial for the Mob. The positive effect of ω is straightforward. A more powerful Mob is expected to appropriate a higher share of the rents in society and thus increase the opportunity costs for both other players. More Citizens are, accordingly, willing to pay protection money (i.e., $\overline{G}\uparrow$) and the Police are thus willing to accept a smaller bribe.

Similar effects are effective for increasing inequality. A rising σ results in more Citizens whose income is significantly different from the mean of the log-distribution e^{μ}, i.e., there are more poor and rich Citizens but fewer average-income Citizens, although the change toward the poorer end is larger. Because poor Citizens are more willing to pay protection money and the Mob still participates in the extortion of high-income Citizens due to collusion, these changes in society's composition reduce the competitive pressure for the Mob and thus increases its relative power. In other words, developments that favor the bargaining position of the Mob (and thus result in higher payoffs to it) yield more stable collusion. Accordingly, collusion collapses when it is not sufficiently beneficial for the Mob.

Those effects are also illustrated by the left graph of Fig. 7, which shows the Mob's share of total societal wealth and allows for a deeper understanding. Here, inequality has a positive effect on the Mob's share of the rents only when the Mob colludes with the Police. Without collusion, better capabilities in a conflict alone (i.e., a larger ω) yield a higher share of the rents $\left(\overline{\pi_M} = \omega\right)$, whereas the remainder remains with the Citizens $\left(\overline{\pi_C} = 1 - \omega\right)$. Accordingly, inequality does not improve the Mob's ability to rely on violence; it improves only its ability to monetize its higher efficiency for extortion. Only when both the Police and the Mob collude will a higher σ as well as a higher ω increase the Mob's share of societal wealth; but, of course, this also decreases the share of the Police, who obtain the remainder.

Three other insights from Fig. 7 are also worthy of mention. First, the Mob's share of collusive rents does not increase gradually. Instead, the tipping point also results in a saltus of the function of $\overline{\pi_M}$ (left side), implying that the breakdown of collusion results in a significant redistribution of rents from both the Mob and the

[21] This can be easily seen from Proposition 2.

Police to the Citizens. Second, the height of the tipping point (i.e., the minimum loss from an end of collusion) is larger not for more or less balanced distributions of relative power ω but instead for those rather *tilted to the Police* (see middle of Fig. 7). Third, as shown by the right side of Fig. 7, the Mob's ability to translate inequality into additional rents (i.e., the slope of the function of $\overline{\pi_M}$) changes with ω and is the highest for more or less balanced capabilities. The latter two allow for a very interesting insight. When the outcome of a conflict is less predictable, or when the odds are even slightly against the Mob, the positive impact (or the relevance) of increasing inequality for the Mob is higher. One potential explanation for this is that the Mob's efficiency may also matter most when the relative power in a violent conflict is less decisive or even against the Mob. In other words, when the outcome of violent conflict becomes less predictable, or even when the playing field is a bit leveled *against* the Mob, the non-violent parameters of relative power (i.e., efficiency) become increasingly relevant and effective.

The impact of inequality and relative power on the Mob's payoffs are illustrated in more detail by Fig. 8. Its left side, illustrating the contours of $\overline{\pi_M}$, again shows that (i) collusion significantly increases the Mob's share of the rents and (ii) without collusion, inequality has no effect on the distribution of the rents. When the Mob and the Police collude, inequality and the relative power become substitutes (i.e., higher inequality allows the Mob to be less powerful while receiving the same share of the rents). These results are not surprising. As we can see from Result 1, the Mob and the Citizens share the rents in the former case, whereas the Mob appropriates all the Citizens' income and splits the loot with the Police in the latter case. In both relations, different parameters are crucial for the actors' relation of power and, thus, for the distribution of the rents. For the Citizens, only the Mob's ability to appropriate their income by violent means is important. The greater the Citizens' expected loss is when they rely on the Police for their security, the more willing they are to forgo a greater share of their income. Rent sharing between the Mob and the Police is instead affected by the relation of the actors' payoffs, which they can appropriate by violent means from the other party and those they obtain "voluntarily" from the Citizens (i.e., as a bribe or protection money). Here, the relation of power ω affects the former, and inequality the latter, because more poor Citizens increase the segments of population who prefer to pay protection money, and vice versa.

The Mob's empowerment by collusion becomes even more visible when π_M^S (i.e., the Mob's share of the rents in excess of/less than ω) is considered. As shown by the middle graph of Fig. 8, collusion enables the Mob to extract rents in excess of its relative power and, contrarily, forces the Police to accept less (i.e., $\overline{\pi_M} > \omega$ and $1 - \omega > \overline{\pi_P} \Leftrightarrow \pi_M^S > 0 > \pi_P^S \; \forall \; s^* > \omega$).[22] The Mob's greater share is a reward for its higher efficiency. More concisely, when colluding, the Mob and the Police jointly monopolize the market of (public) security. Due to its higher efficiency in extortion, the Mob specialize in the criminal enterprise, and both the Mob and the Police are thus able to appropriate a greater share of the total wealth. As a return, the Mob receives a greater share of the rents. As argued before, the collusive rent

[22] As a corollary of the Proof of Proposition 3, this must be true for all collusive equilibria.

sharing thus reflects not only the relative distribution of power in a violent conflict but also the relative contributions to the joint criminal enterprise. Accordingly, the Mob's higher efficiency in extortion becomes crucial only in relation to the Police and can thus be monetized only when both collude.

Given those results regarding the impact of inequality and relative power on the distribution of rents, it is interesting to see that both parameters do not have the same continuous effect on the Mob's ability to monetize its relative power or its higher efficiency in extortion, respectively. The latter can also be seen from middle graph of Fig. 8. Whereas inequality always has a positive effect, the relative power maximizes the share of the rents from specialization on extortion only for more balanced violent capabilities. In other words, the Mob, again, appears to become more able to monetize its efficiency advantage as the outcome of a conflict becomes less predictable. This interpretation is in line with the observation regarding the Mob's ability to translate a rising inequality into larger shares of the rents as well as the height of the tipping points. However, as shown by the right side of Fig. 8, the relevance of the Mob's higher efficiency increases with decreasing relative power. In other words, the less the Mob can rely on violence, the greater the impact of its higher efficiency on its share of the rents. As this share absolutely decreases, the share of the specialization on extortion increases.

6 Discussion

We have shown that criminal collusion is more likely in localities that suffer from high inequality or weak law enforcement. Our model has also revealed (i) that the transition from the competitive equilibrium to the collusive equilibrium is a tipping-point phenomenon, whereby (ii) (low-key) extortion—but no corruption at all—exists without collusion. The total societal welfare, however, is not affected by the extent of corruption and organized crime in society,[23] although who obtains the rents differs significantly in both situations. Only in the absence of collusion are the Citizens able to retain at least a part of their income. Thus, the competitive equilibrium should be preferred. Accordingly, it should be of particular interest to discuss ways to end criminal collusion (or to prevent its emergence) and how to contain organized crime.

It is, however, clear that the elimination of public security in our model implicitly presupposes the existence of a culture of corruption in the security forces and that, in general, the police are always willing to accept bribes. More concisely, despite the existence of laws against corruption, the society (or, at least, the public agencies) lacks social norms against corruption that foster compliance with the law. This assumption, particularly in its absolute case, is surely not true for most countries

[23] There are, of course, societal costs of organized crime, even if we—as we do in this model—neglect the mobsters' investments in extortion, i.e., the transfer costs of rent-seeking (Tullock, 1967, 1971) For example, there is extensive evidence that continuous extortion has a negative impact on (private) investments and thus on economic growth (Pinotti, 2015a, b).

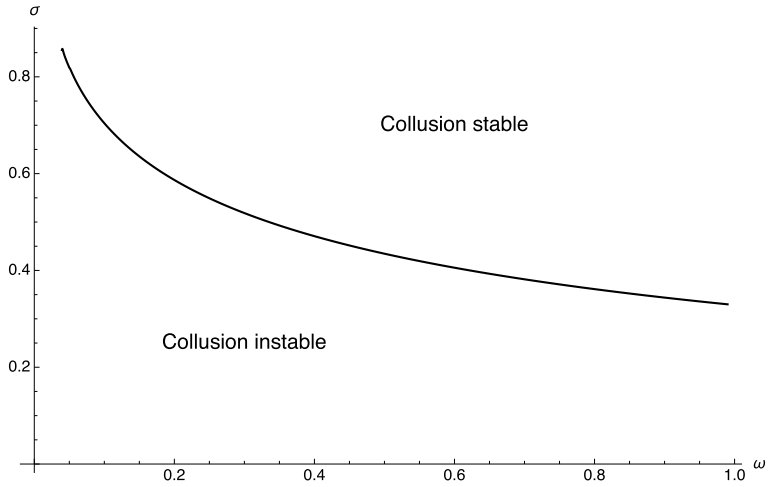

Fig. 6 Illustration of the tipping points' locations. Lognormal distributions used for $F(\cdot)$ with standard deviation σ and mean $\mu = 0$. Inequality increases with increasing σ. The code to derive the tipping points can be requested from the author

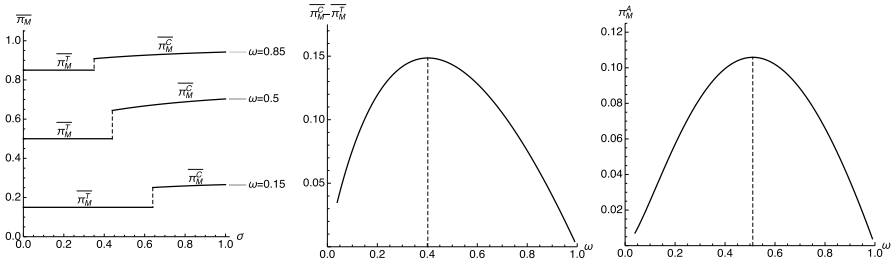

Fig. 7 Mob's share of $K(\infty)$, i.e., $\overline{\pi_M}$, (left), height of tipping points ($\overline{\pi_M^C} - \overline{\pi_M^T}$) and average slope (right). Lognormal distributions used for $F(\cdot)$ with standard deviation σ and mean $\mu = 0$. Inequality increases with increasing σ. Average slope $\pi_M^A = \Delta\overline{\pi}/\Delta\sigma$. The code to compute the graphs can be requested from the author

worldwide; however, this does not justify a hasty dismissal of our arguments' validity. First, our model does not rely on the existence of completely corrupt public administrations on all levels, such as we might identify with so-called "Narco-states" or "Mafia states." Rather, individual corrupt police units at key positions should be quite capable of eliminating large areas of public security in remote localities.[24] Such corrupt units are often protected by cultural characteristics of police forces that impede the enforcement of the law within law enforcement agencies. Even incorruptible police officers often remain silent in the face of corruption by their peers

[24] E.g., for 19th-century Sicily, Bandiera (2003, p. 225) argues that the Sicilian militia (i.e., "companies at arms") were often composed of former criminals, whose "knowledge of former colleagues [...] often resulted in collusion rather than persecution".

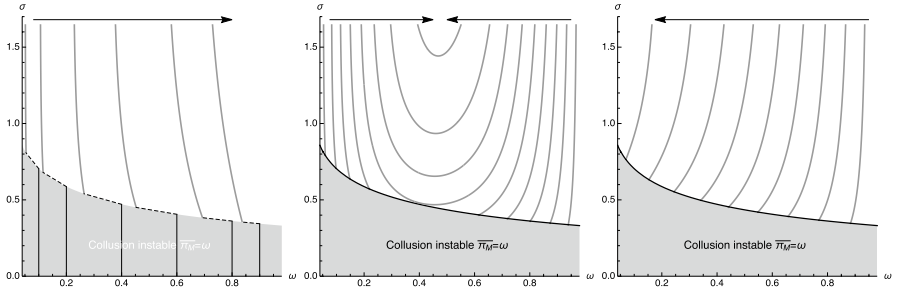

Fig. 8 Contours of the Mob's share of total wealth $\overline{\pi_M}$ (left), of the Mob's additional share from collusion π_M^S (middle) and of the share of π_M^S on the Mob's total share $\pi_M^S/\overline{\pi_M}$ (right). Lognormal distributions used for $F(\cdot)$ with standard deviation σ and mean $\mu = 0$. Inequality increases with increasing σ. Average slope $\overline{\pi_M'} = \Delta\overline{\pi}/\Delta\sigma$. The code to compute the graphs can be requested from the author

due to a culture "characterized by a high degree of internal solidarity and secrecy" (Newburn, 1999, p. 17). Second, police corruption is in fact a severe and widespread problem in many countries, and the police are often seen as the society's most corrupt institution (Pring, 2017, p. 5).

Even if the latter appears to be particularly true for developing countries, it must be borne in mind that police forces in developed countries are also vulnerable to corruption. Furthermore, the risk for developed countries may often be underestimated due to the common tendency to trivialize police corruption as isolated incidents perpetrated by "rotten apples," a "canard" thoroughly discredited by "too many examples of institutionalised corruption" (Newburn, 2015, p. 7).[25] Given those considerations, the best way to prevent collusion between organized crime and police forces is to contain this *willingness to be corrupt* or, at least, the various opportunities for corruption. However, changing the "culture" in public administration (i.e., establishing social norms opposing corruption) would require extensive institutional reforms and likely would have negligible short-term effects, if any. Nevertheless, especially in those countries with a dysfunctional public administration, actions targeting alliances between organized crime and security forces should always be accompanied by institutional reforms aimed at the roots of corruption.

Despite those needed societal changes, our model suggests that societies suffering from widespread criminal collusion have two obvious instruments to challenge the alliance between police forces and mobsters: First, they could empower law enforcement and, second, they could try to lower inequality. According to our results, both instruments are appropriate for incentivizing opportunistic behavior by the criminal organization, which results in a breakdown of collusion. Nevertheless, there are caveats for both instruments that eventually render them unsuitable for bringing

[25] For the US, the New York Police Department is a striking example; since the 1970s, two public commissions (Knapp and Mullon) have revealed widespread systemic corruption in the department.

corruption and criminal rule to an end. Reducing inequality, on the one hand, may often be seen as a desirable policy goal due to (politically favorable) social justice, welfare or political economy considerations. On the other hand, inequality is also very rigid, and only major events such as modern mass-mobilizing warfare, transformative revolutions (in particular: communism), state collapse, or uncontrolled pandemics should be able to significantly reduce inequality in short periods of time (e.g., Scheidel, 2017).[26] Because gradual changes in inequality may be ineffective due to the tipping-point-nature of collusion, justifiable doubts exist as to whether reducing inequality is a plausible challenge to collusion between a criminal organization and law enforcement, at least in the short term. In addition, reducing inequality eventually results in a failure of collusion (and, thus, in a significant increase of the Citizens' welfare) but it does not further improve the latter's share of the rents once collusion ends. Only the relative power of the Police vis-a-vis the Mob then improves the Citizens' welfare.

Strengthening law enforcement is therefore an essential instrument,[27] but this approach could be a double-edged sword. Only in the absence of collusion, or when a more powerful Police force results in an end of collusion, does increasing the Police's capabilities yield greater Citizen welfare. Otherwise, improvements of the Police only shift the power balance between them and the Mob and enable the former to enforce higher bribes. Moreover, even if the tipping point is crossed and collusion breaks up, the end of collusion is *not* a result of the containment of organized crime. Instead, collusion ends due to opportunistic behavior (i.e., the police do not stop being corrupt; rather, there is merely no one willing to bribe them). Furthermore, strengthening the police force in such an anarchic, dysfunctional environment could also backfire when, instead of being a counterbalancing factor to the criminals, a powerful police force eliminates the mobsters, takes over the latter's position and monopolizes the market for extortion themselves. In that case, the Police themselves would turn into a criminal organization that extorts protection money from the Citizens.[28] Based on these considerations, it is again at least doubtful whether empowering the local police forces is an expedient instrument to (re-)establish the

[26] However, all those developments should also ruin state capacity, reduce states' ability to monitor (remote) localities, and thus empower local organized crime groups.

[27] There is empirical evidence that more police officers (Corman & Mocan, 2000; Levitt, 1997, 2004) as well as an increased police presence generally reduce crime (Di Tella & Schargrodsky, 2004). See Levitt and Miles (2006) for a survey of the literature.

[28] We must credit an anonymous referee with the insight that violent monopolization deserves more attention. Naturally, the Mob would never violently monopolize the market as it could never expect to gain a higher share of the rents (see the previous section). We also investigated the possibility that the Police try to expel the Mob and monopolize the market for extortion themselves. It turns out that when the Mob and the Police collude, such an endeavor is beneficial only for very weak police forces. In the case of the Police's exclusion from rent participation, the decision on violent monopolization depends on its costs. Because monopolization is not at the core of the current analysis, we forgo a more detailed presentation (results available from the author on request). However, monopolization by police forces is not pure fiction. In 1984, the Key West Police Department was declared a "criminal enterprise" due to the involvement of high-ranking officers in the drug trade (New York Times, 1984) "Los Zetas," one of Mexico's most powerful drug cartels, have their roots in the special forces of the Mexican Army.

rule of law unless the root of the problem—i.e., widespread willingness to be corrupt—is also targeted.

Given those considerations, our model implies that societies should *not only* resort to the usual instruments to counter crime when confronted with a criminal complex of an organized crime group and a corrupt police in a locality. A more promising tool appears to be the centralization of law enforcement in order to challenge the local culture of corruption and to strengthen the reliability of local public security. This can be achieved by relying on external (e.g., special, military, central government, or even foreign) law enforcement agencies that have only weak ties to the region of conflict. Such an approach makes it possible to immediately change the "culture" in law enforcement as new centralized units do not have a long-term relationships with local mobsters and are also more easily monitored by a central government.[29] The example of the decline of the American Mafia from the beginning of this paper illustrates that this strategy could be successful when local political machines are dissolved due to the involvement of external agencies.[30] The consequences of the existence of such an "incorruptible" police actor in our model are easy to show. Assuming that such new "Federal Police" would provide the same public security as the original Police, but for free (i.e., $T = 0$) and, hence, that the former would oust the latter, it becomes clear from the Proof of Proposition 3 that the Mob now has incentives to "undercut" (i.e., $s = \omega$) the new law enforcement agency. Accordingly, the existence of "incorruptible" Police yields the competitive equilibrium and, hence, a non-violent monopolization the market, irrespective of ω and σ. This change not only results in more favorable distributions of the rents but also makes traditional instruments more effective—because now, improving the effectiveness of law enforcement directly decreases the extent of extortion. These considerations again illustrate the importance of addressing the local "culture of corruption" for challenging both corruption and organized crime.

Apart from public agencies, civil society can also play a crucial role in countering organized crime and corruption, as a very interesting example from Sicily indicates.[31] In 2004, the organization "AddioPizzo" ("goodbye protection racket") was founded in Palermo, Italy, by local entrepreneurs who started to refuse to pay "pizzo" (protection money) themselves, to promote critical consumption (i.e., pizzo-free shops and businesses), and to assist victims of extortion.[32] Surprisingly, the organization was able to persist, slowly increase its network (at the end of 2022, AddioPizzo had almost 1000 corporate members), and mobilize others, without

[29] Similarly, Newburn (1999) highlights decentralization and ties to local politics as risk factors for the integrity of (local) police forces.

[30] The war on drugs in Colombia also appears to be an example of at least limited success. See Llorente and McDermott (2014) for a general overview and Benítez Manaut (2014) for an overview of US aid in fighting drug trafficking.

[31] We are very thankful to an anonymous referee for bringing this example to our attention.

[32] There are, of course, many more anti-mafia movements and organizations from civil society, but AddioPizzo is one of the best known.

being lethally crushed by the mafia.[33] Even if the direct impact of AddioPizzo may not appear to be very large, it has had widespread consequences for the society as a whole. First of all, it increases public awareness of the problem of extortion, which was more or less completely ignored by the general public before. Furthermore, the organization started a development of changing the local culture toward the payments of protection money. Now, formerly non-activist citizens have become aware that there are opportunities to oppose the mafia without great risk and effort and—perhaps more importantly—of the economic costs of extortion (Gunnarson and Forno, 2015, p. 112f.). This awareness lowered the obstacles to participation in an anti-mafia movement, particularly as it prevented a direct confrontation with the mafia. Subsequently, more organizations emerged, and business associations also started to publicly denounce the payment of protection money.

Based on these observations, Lipari and Andrighetto (2020, p. 229) conclude that AddioPizzo was able to contain the payment of protection money because it changed "the existing social norm of paying *pizzo* and not reporting the request to the authorities, into a new social norm of not paying *pizzo*." Unlike the sole change of laws or rules, the authors argue, AddioPizzo was able to affect the citizens' shared social expectations, triggering a social change against the payment of protection money and thus motivating the citizens to better obey the existing laws against extortion. These results emphasize (i) the importance of the civil society for the change/emergence of social norms and (ii) the relevance of social norms against corruption for challenging organized crime. The latter observation was already highlighted by Akerlof and Yellen (1994, p. 175), who points to the "necessity for strong community norms against crime [...and] that in the absence of sufficiently strong norms, there is the frightening possibility that crime will increase indefinitely" and by Cayli (2013, p. 97), who identifies a "culture of lawfulness [...as] critically significant and the most effective factor in combating the Mafia."

7 Concluding remarks

In this paper, we analyze how unlawful cooperation may arise between security forces and criminal organizations in dysfunctional local societies characterized by weak property rights, absent social norms against corruption, and a power vacuum. With the help of a game-theoretic model, we show that this kind of collusion with the aim to exploit the citizens is more likely in societies with an unequal distribution of income or a less powerful local police force. From the perspective of welfare economics, our analysis shows that whether the criminal organization and law enforcement collude or compete has very different distributional effects. Without collusion, the mobsters claim only a rather small share of societal wealth, whereas the citizens are able to maintain the remainder. In this situation, organized crime non-violently

[33] The US consulate in Naples, Italy, reported that members of AddioPizzo receive additional police protection and that the organization was formed at the very right moment, when the local mafia was weakened by numerous arrests or convictions (Consulate Naples, 2007).

monopolizes the market for extortion by applying a predatory pricing strategy. Competition for protection money/bribes thus reduces the scope for extortion, similar to the situation on an ordinary market. When, however, the criminal organization and the police force come to an agreement, the criminals appropriate all the societal wealth and share the loot with the police; the citizens are thus completely robbed. Collusion here is clearly beneficial for the criminal organization, which is able to monetize its higher efficiency in extortion, which results from the mobsters' ability to discriminate citizens according to income so as to extort income-dependent protection money from them. Interestingly, the organized crime group's ability to extract rents relies solely on its violent capabilities when it competes with the security forces—although then, the latter do not engage in the market for extortion and thus do not interfere with organized crime. This surprising behavior results from the police forces' potential competition, which limits the monetization of the mob's higher efficiency. Such a monetization and, hence, non-violent capabilities, become relevant only in case of collusion. Somewhat counterintuitively, our analysis here grants the insight that the criminal organization is better able to utilize its non-violent means when the playing field is more or less balanced or even slightly leveled against it.

Finally, we conclude from our discussion above that policy measures intended to impede collusion between public agencies and organized crime groups should aim at the basis of cooperation between both partners—that is, the willingness to engage in corrupt activities. As we have argued and demonstrated, collusion collapses when opportunistic behavior becomes dominant for the criminal organization. This occurs when the mobsters can no longer credibly commit to a strategy of joint rent maximization but rather start to lower their demand for protection money in order to attract more citizens. This deviation can be triggered by increasing the relative gains from competition. We have also argued that without strong social norms against corruption, policy instruments to counter organized crime and corruption are blunted, if not useless. Accordingly, politics should aim at dissolving local political machines while targeting organized crime and corruption together and thereby tackle the roots of the problem: a widespread "culture of corruption" in society. Those considerations are in line with current research, which indicates that policies which fail to address corruption and organized crime together may be ineffective or may even have opposite effects (see, e.g., Buscaglia, 2008; Kugler et al., 2005). In this regard, civil society could play a crucial role, which may allow for social change, intensifying the impact of political actions. Accordingly, anti-mafia movements from civil society should receive more attention by public agencies and should be considered as complements to political measures.

In the end, our considerations allow for another interesting insight that further substantiates the common analogy between organized crime and companies: Collusion between a criminal organization and law enforcement with the aim to prey on society is not very different from corporate collusion between firms on a market. In both situations, policy instruments increasing the risk of opportunism destabilize collusion and can thus result in fierce competition between the former allies. Accordingly, cartel theory may allow for more insights into approaches for challenging organized crime.

Appendix A: Proofs

A.1: Proof of Lemma 1

Citizens are not able to defend themselves. Accordingly, without any protection (i.e., $\omega = 1$), a Citizen will definitely lose all of their income $\left(\pi_C = 0\right)$. At the same time, paying the Mob always results in non-negative payoffs $\pi_C^S = (1 - s)\dot{G} \geq 0$, which is thus preferable. To sum up, without any public security, irrespective of whether the Citizen is unwilling to pay a bribe or whether the Police refuse the bribe, the Mob would definitively appropriate the Citizen's income, and the latter is always better off by paying at least the Mob. In addition, it is also never rational for a Citizen to pay both actors. A Citizen with income $\dot{G}$ who bribes the Police and pays protection money to the Mob would have a payoff $\pi_C = (1 - s)\dot{G} - T < (1 - s)\dot{G} = \pi_C^S$, which is, for $T > 0$, always smaller than their payoff when paying only the Mob π_C^S.

A.2: Proof of Lemma 2

Substituting $s \leq \omega$ in Eq. (7) reveals that all Citizens "voluntarily" pay protection money because paying the Mob is always preferable irrespective of $T \in \mathbb{R}_0^+$. This is also the right strategy for the extreme case of $s = \omega$ and $T = 0$, even as a Citizen is then nominally indifferent between paying the Mob and bribing the Police. However, because paying the Mob results in a secure payoff and bribing the Police is a payoff at risk, it seems obvious that a Citizen would pay the Mob in this situation. Accordingly, because all Citizens "voluntarily" pay protection money, the Mob obtains the maximum achievable payoff

$$\pi_M^T = sK(\infty)$$

even without colluding with the Police. Given the Mob's payoffs when bribing the Police in Eq. (12), the Mob has no willingness to pay for collusion (i.e., to bribe) for $s \leq \omega$.

A.3: Proof of Proposition 1

Rearranging (8) to $T = (s - \omega)\overline{G}$ and substituting in (11) yields

$$\underline{B} = (s - \omega)F\left(\underline{G}\right)\overline{G} \tag{A1}$$

for the minimum bribe. Substituting Eqs. (14) and (A1) in $\overline{B} > \underline{B}$ yields

$$\overline{B} = (s - \omega)K(\underline{G}) > (s - \omega)F(\underline{G})\ \overline{G} = \underline{B}, \tag{A2}$$

which can be rearranged and canceled to

$$K(\underline{G}) > F(\underline{G})\,\overline{G}. \tag{A3}$$

For $s > \omega$ and, as defined at the beginning, $T \in \mathbb{R}_0^+$, implying $\overline{G} \geq 0$, Eq. (A3) is always true. This can be easily explained: The equation's left side displays the aggregated income of all Citizens with an income of $\overline{G}$ *or higher*, which must always be greater than the aggregated income of the same number of Citizens $\left[F(\underline{G})\right]$, who *all* have an income of only $\overline{G}$, i.e., the equation's right side.

At the same time, it should intuitively make sense that Eqs. (A2) and (A3) cannot be true for $s \leq \omega$ and for $s < \omega$ in particular, due to $G \in \mathbb{R}_0^+$ but also, as argued in the Proof of Lemma 1 in Appendix A.2, due to the Mob's lack of willingness to offer a bribe for $s \leq \omega$. The Mob's reluctance to bribe can be seen more formally from Eq. (14), after which $\overline{B} \leq 0$ holds true for $s \leq \omega$. It is nonetheless helpful to examine the corner case $s = \omega$ in more detail, for which $\overline{G}$ is undefined. The limit values reveal that

$$\lim_{s \to \omega} \overline{G} = \frac{T}{s - \omega} = +\infty \tag{A4}$$

and, accordingly,

$$\lim_{s \to \omega} K(\underline{G}) = 0 \quad \text{and} \quad \lim_{s \to \omega} F(\underline{G}) = 0. \tag{A5}$$

This implies that Eqs. (A2) and (A3) cannot be true for $s = \omega$. Furthermore, we can also derive from Eq. (A5) that $s = \omega$ also yields $\overline{B} = \underline{B} = 0$ and, consequently, $R = 0$. This should be intuitively comprehensible because the Mob's lack of any willingness to pay bribes results from this lack of any rent from collusion.

A.4: Proof of Proposition 2

In order to present the relevant subgames' equilibria, we solve the game tree in Fig. 4 using backwards induction, starting with the players' decision to comply with the agreement or to defect from it. For the sake of comprehensibility, we also consider under which condition the actors would enter into the agreement, even if such a formal declaration of intent is not included in the game tree, because it is helpful to understand the players' strategic reasoning on the offers θ_M, θ_P. In addition, it is important to be aware that, according to Proposition 1, $s > \omega$ implies $\overline{B} > \underline{B}$ and thus $R = \overline{B} - \underline{B} > 0$ and that, in turn, $s \leq \omega$ implies $R = 0$.

Regarding compliance with a given agreement, both players take their respective shares θ_M and θ_P of the rent, s, and T as given, and defect from the agreement when defection promises higher benefits than compliance, i.e., when $\pi_i^F > \pi_i^C$ (with $i = M, P$) holds true. Substituting Eqs. (16) and (17) yields

$$\pi_M^F = \pi_M^T + \omega R > \pi_M^T + \theta_M R = \pi_M^C \tag{A6}$$

for the Mob and

$$\pi_P^F = \pi_P^T + (1 - \omega)R > \pi_P^T + \theta_P R = \pi_P^C \tag{A7}$$

for the Police. According to Eq. (A6) and for $s > \omega$, the Mob defects from the agreement when $\theta_M < \omega$ and, according to Eq. (A7), the Police defect when $\theta_P < 1 - \omega$. For $s \leq \omega$ and, thus, $R = 0$, the Mob as well as the Police are both indifferent between compliance and defection (i.e., $\pi_i^F = \pi_i^C$) and, as assumed, would comply with the agreement.

Regarding concluding an agreement, both players again take their respective shares θ_M and θ_P of the rent, s, and T as given, and would enter all agreements (with $i = M, P$) for which

(i) $\pi_i^F > \pi_i^T$ holds true when at least one player will defect and
(ii) $\pi_i^C > \pi_i^T$ holds true when both players will comply.

Again, substituting Eqs. (16) and (17) and rearrange them yields that, for $s > \omega$, the Mob would enter all agreements when $\omega > 0$ (first case) or $\theta_M > 0$ (second case) holds true but would not enter an agreement for $s \leq \omega$. For $s > \omega$, the Police would enter all agreements when $1 - \omega > 0$ holds true in the first case or when $\theta_P > 0$ in the second case, and would not enter an agreement for $s \leq \omega$.

Based on these considerations, it is clear that there are only two equilibria regarding the players' offers for θ_M and θ_P: First, there is no agreement (i.e., no offers) for $s \leq \omega$ because no rent from cooperation then exists, and no player would enter an agreement to split a non-existent rent. Second, a single subgame-perfect equilibrium exists for $s > \omega$, which ensures a stable, agreement that is complied with and that consists of the offers $\theta_M = \omega$ and $\theta_P = 1 - \omega$ from both players. In the former case, "no offers" is a stable (subgame-perfect) Nash equilibrium because $\pi_i^C = \pi_i^F = \pi_i^T$ holds true for both players due to $R = 0$. Accordingly, no player has an incentive to deviate unilaterally. The same is true in the latter case. Every other offer for θ_M and θ_P is (weakly) dominated by $\theta_M = \omega$ and $\theta_P = 1 - \omega$ because (i) all higher offers for oneself result in either a breakdown of the negotiations when $\theta_M + \theta_P > 1$ or in non-compliance by the other player due to $\theta_M < \omega$ or $\theta_P < 1 - \omega$, and (ii) all smaller offers for oneself would induce the same player to defect from the agreement. Accordingly, no player is able to increase its payoff by deviating unilaterally.

Based on these considerations, it is also clear that costs of conflict should not necessarily change the equilibria, although the players are more reluctant to fight for the rent. Because trying to take advantage of the other player's relative reluctance increases the risk of a breakdown of the negotiations due to $\theta_M + \theta_P > 1$, both players should refrain from utilizing the opponent's disadvantage and should still offer $\theta_M = \omega$ and $\theta_P = 1 - \omega$.

A.5: Proof of Proposition 3

In this proof, we use the following approach, which is illustrated by Fig. 5: The figure shows that the Police appear to have an optimal reaction T^* to s (we will show that in the proof), whereas for the Mob there can exist (i) a corner solution

at $s = 1$ as well as (ii) a local maximum at $s_L \in]\omega, 1[$ for a given T. In addition, the Figure also suggests that (i) the corner solution can be stable only if it promises the highest possible payoff for the Mob given the Police's best answer T^* and (ii) when the corner solution becomes unstable, the Mob significantly reduces (i.e., a non-gradual change) its extortion rate from $s = 1$ to a local maximum s_L. The Mob in turn induces a change of T by the Police, resulting in a new equilibrium.

In order to prove Proposition 3, we will show the following in this section:

1. $s = \omega$ and $T = 0$ is always a Nash equilibrium but the Police and the Mob do not collude under these conditions.
2. $s = 1$ and $T = T^*$ is a Nash equilibrium and dominates the Nash equilibrium at $s = \omega$ and $T = 0$ given $\forall\, s \geq \omega : \pi_M^C(s = 1, T^*) > \pi_M^C(s, T^*)$.
3. There is no stable equilibrium for $s \in]\omega, 1[$.

Regarding 1 As shown in the Proof of Proposition 1 in Appendix A.3, all Citizens pay protection money to the Mob for $s = \omega$ regardless of T and, consequently, no one (including the Mob) is willing to bribe the Police. Proposition 2 yields that no collusion then occurs under these conditions. Accordingly, the Mob's payoff is $\pi_M = s\,K(\infty) = \omega\,K(\infty)$ and the Police's payoff is $\pi_P = 0$. Obviously, the Mob's payoff decreases if s drops further below ω. At the same time, increasing s above ω would incentivize all Citizens to bribe the Police due to $T = 0$ and, according to Eq. (13), the Mob's payoff would again be $\pi_M = s\,K(0) + \omega\,K(\infty) = \omega\,K(\infty)$. The Police also cannot increase their payoff by revising T: A negative T, which is not possible due to $T \in \mathbb{R}_0^+$, would nonetheless lower the Police's payoffs, whereas a higher T would leave the payoffs unaffected. Accordingly, the Police also have no incentive to unilaterally deviate from this situation.

It is, however, also clear that all combinations of $s = \omega$ and $T \geq 0$ constitute Nash equilibria because no player has incentives to change their strategy for the opponent's given strategy. Nonetheless, $s = \omega$ and $T = 0$ is still the most likely equilibrium, given more recent research on the similar situation of asymmetric Bertrand competition (e.g., Demuynck et al., 2019). However, even applying other research (e.g., Blume, 2003; Kartik, 2011), which would argue for a mixed equilibrium consisting of the Mob setting $s = \omega$ and the Police randomizing on an interval $T > 0$, would not change the model's outcome. As long as $s = \omega$ holds true, there is no collusion between the Mob and the Police because then, $\overline{B} = \underline{B} = R = 0$ also holds true, eliminating any room for an agreement.

Regarding 2 To develop some intuition for this as well as the next results, we will consider the first-order conditions for an optimum in more detail, starting with the Mob. The first-order condition of an optimum of π_M^C yields

$$\begin{aligned}\frac{\partial \pi_M^C}{\partial s} &= K(\infty) - f(\overline{G})\,\frac{T^2}{(s-\omega)^2} \\ &\quad - (1-\omega)\left[K(\underline{G}) + (s-\omega) f(\overline{G})\,\frac{T^2}{(s-\omega)^3} - f(\overline{G})\,\frac{T^2}{(s-\omega)^2}\right] \\ &= K(\infty) - (s-\omega)K_s'(\underline{G}) - (1-\omega)K(\underline{G}) \overset{!}{=} 0\end{aligned} \tag{A8}$$

which can be reformulated to

$$(1-\omega)\overline{K}(\underline{G}) + (s-\omega)\frac{K_s'(\underline{G})}{K(\infty)} = 1. \tag{A9}$$

Equation (A9) illustrates that, depending on T and on the distribution of income, i.e., $f(\cdot)$, there can be situations with and without an optimum for the Mob.

The first-order condition of π_P^C for the Police yields

$$\begin{aligned}\frac{\partial \pi_P^C}{\partial T} &= F(\underline{G}) + f(\overline{G})\,\frac{T}{(s-\omega)} \\ &\quad + (1-\omega)\left[(s-\omega)\left(-f(\overline{G})\,\frac{T}{(s-\omega)^2}\right) - F(\underline{G}) + f(\overline{G})\,\frac{T}{(s-\omega)}\right] \\ &= \omega F(\underline{G}) - f(\overline{G})\,\frac{T}{(s-\omega)} \overset{!}{=} 0\end{aligned} \tag{A10}$$

which can be reformulated to

$$\omega = \frac{f(\overline{G})\,\overline{G}}{1 - F(\overline{G})}. \tag{A11}$$

Based in these considerations, it is only of matter of definition that

$$\begin{aligned} s^* = 1 \quad \text{and} \quad T = T^* \quad & \forall\, T : \pi_P^C(s^*, T^*) \geq \pi_P^C(s^*, T) \\ & \forall\, s \geq \omega : \pi_M^C(s^*, T^*) \geq \pi_P^C(s, T^*) \end{aligned} \tag{A12}$$

is a stable Nash equilibrium. The intuition for this consideration is illustrated by Fig. 5. For the Mob, $s = 1$ is a rational choice only when the payoff is highest there, given a rational reaction by the Police. In other words, when $s = 1$ is the highest point of π_M^C (as on the right side of Fig. 5) irrespective of possible local maxima, the Mob has no incentive to unilaterally deviate from it. At the same time, as T^* is defined as the Police's optimal reaction, the same is true for the Police. To sum up, given that there is no payoff higher than $s = 1$ for the Mob, this corner solution is stable. Furthermore, it also dominates the equilibrium at $s = \omega$ and $T = 0$ because now, due to $R > 0$, $\pi_i^C > \pi_i^T$ with $(i = M, P)$ always holds true.

Regarding 3 A necessary but not sufficient condition for a Nash equilibrium is

$$\frac{\partial \pi_M^C}{\partial s} = \frac{\partial \pi_P^C}{\partial T},$$

which is an interception of the first-order conditions but not necessarily of the players' best response functions, which imply that the first-order conditions are intercepting *and* being zero at the same time.

Expanding Eq. (A10) with $\overline{G} = T/(s-\omega)$ and rearranging yield

$$\omega F(\underline{G})\,\overline{G} = f(\overline{G})\,\overline{G}^2 = f(\overline{G})\,\frac{T^2}{(s-\omega)^2}. \tag{A13}$$

This equation's right side in turn equates to $(s-\omega)K_s'(\underline{G})$. At the same time, Eq. (A8) can be rearranged to

$$K(\infty) - (1-\omega)K(\underline{G}) = (s-\omega)K_s'(\underline{G}) \tag{A14}$$

Equating the right sides of Eqs. (A13) and (A14) and, again, rearranging yields

$$K(\overline{G}) = \omega\Big[F(\underline{G})\,\overline{G} - K(\underline{G})\Big] \tag{A15}$$

Finally, Eq. (A15) cannot be true for $s > \omega$ because, as shown in the proof for Proposition 1 in Appendix A.3 (see Eq. (A3) for details), the equation's right side is then always negative, whereas its left side is always positive. Accordingly, there is no interception of both first-order conditions and, hence, both players' best response functions have no interception, eventually constituting a Nash equilibrium. Consequently, the only Nash equilibrium that results in a collusive agreement between the Mob and the Police is the corner solution at $s = 1$.

To sum up, when π_M^C has a local maximum at s_L because

$$\begin{gathered}\pi_M^N\left(s_L, T^*\right) \geq \pi_M^N(s, T^*) \quad \forall\, s \in]\omega, 1),\ \exists\, \epsilon > 0 \quad \text{with} \quad |s - s_L| < \epsilon \\ \text{with} \quad \forall\, T : \pi_P^C(s^* = 1, T^*) \geq \pi_P^C(s^* = 1, T)\end{gathered} \tag{A16}$$

holds true *and* $\pi_M^N\left(s_L, T^*\right) \geq \pi_M^N(s = 1, T^*)$ also holds true, an eventual equilibrium at $s = 1$ and $T = T^*$ would not be stable. Accordingly, $s = \omega$ and $T = 0$ is then the only Nash equilibrium because no other stable equilibrium exists for $s \in]\omega, 1[$. When, instead, $\forall\, T : \pi_P^C(s^* = 1, T^*) \geq \pi_P^C(s^* = 1, T)$ and $\forall\, s \geq \omega : \pi_M^C(s^* = 1, T^*) \geq \pi_P^C(s, T^*)$ holds true, irrespective of the existence of a local maximum at s_L, the corner solution $s = 1$ and T^* is stable and also dominates the equilibrium $s = \omega$ and $T = 0$. Accordingly, both actors are able and willing to collude in this case due to $R > 0$.

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