Search for a Theory of Organized Crimes

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Abstract: Casual empirical observations indicate that there exists no systematic relationship between the overall crime rate and organized criminal activity. The present paper develops a general-equilibrium search-theoretic framework to study the interactions not only between the formal labor market and the crime sector but also within the crime sector between individual and organized crimes. We emphasize that individual and organized criminals face different arrest risk, success rates, reward structures and outside options. In a criminal organization, the commission is determined by bargains between the mafia and his criminal crews. We characterize the rational individual agent's occupational choice under a given victimization rate and then solve the steady-state equilibrium with endogenous victimization. We then quantitatively examine how the unemployment and the overall crime rates as well as the composition of the two types of crimes respond to changes in labor-market conditions, crime-deterrence policies and the hierarchical structure of the criminal organization.

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1 Introduction

During the post-WWII period, the rise in criminal activity has become a severe socioeconomic problem throughout the world. In 2008, six countries had extremely high overall crime rates (measured by total crime incidents per capita) that exceeded 5%, including the UK (as high as 10.6%), the Netherlands, Germany, Canada, France and South Africa, in order from high to low. In the same year, the overall crime rate in the U.S. was 3.9%, with the total of 11.9 million crime incidents being the highest number for any country in the world. In recent years, criminal activities have exhibited divergent trends across countries: while the overall crime rate in the U.S. has declined, the comparable figures in many European countries have risen. Of particular interest, there appears to be no systematic relationship between the overall crime rate and organized criminal activity. Nowadays in Italy, the overall crime rate remains high (3.7%) and the top 4 or 5 mafia families (*La Cosa Nostra* or "Our Thing") continue to threaten Italian society. Similarly, the UK exhibits not only the highest overall crime rate but also very active organized crime.[1] While the overall crime rate in Japan is relatively low in comparison to that of Western countries (2.2%), organized criminal syndicates (*boryokudan*) inclusive of the Yamaguchi-gumi are extremely active. Moreover, while the numbers of crime incidents in Russia and the U.S. have recently been falling sharply, the numbers of crimes committed by organized groups continue to rise.[2] So far, the G8 and the United Nations have devoted resources to combating criminal gang activities and organized crime, although such attempts have shown little success.[3]

What are, then, organized crimes and why do such crimes concern both the public and policymakers? The term "organized crime" formally means that (i) a crime is committed with the collaboration of two or more people (Elvins, 2003) and (ii) there is a formal organization, i.e., a criminal hierarchy, that coordinates and manages a portfolio of these people's risky activities their activities (Fiorentini and Peltzman 1995) and enhances the group's coordinated business (Abadinsky 1994).[4] Organized crime is considered to be major threats to human security, impeding the

[1] In 2007-08, there were 2,800 organized crime groups in the UK (almost three times more than had been previously divulged), which have been estimated to result in a social cost of at least £20 billion a year.

[2] In the absence of accurate data, we use the gang population to measure organized crime. Based on the National Gang Intelligence Center Report, all U.S. cities with 250,000 or more population reported criminal gang activities in 2008, where the total gang population was estimated to be about 900,000 in 2008, up from 700,000 in 2005.

[3] See, for example, Curry and Mongrain (2008) and Finklea (2009).

[4] The FBI defines organized crime as any group having some manner of a formalized structure whose primary objective is to obtain money through illegal activities. Such groups maintain their position through the use of actual or threatened violence, corrupt public officials, graft, or extortion, and generally have a significant impact on the

social, economic, political and cultural development of societies worldwide.[5] It is a multi-faceted phenomenon and has manifested itself in different activities, including, among other things, drug trafficking, trafficking in human beings, trafficking in firearms, the smuggling of migrants, and, money laundering, etc.

The aforementioned observations with regard to crimes lead to a number of questions that deserve our attention. What are the underlying driving forces leading to the different criminal activity outcomes in these countries? Why would the trends in individual and organized crimes be divergent over the past few decades? Could conventional labor-market or crime-deterrence policies be effective in reducing both individual and organized crimes? In order to address these questions, we construct a general equilibrium model of crimes with the following special features:

- We will allow for dynamic interactions between a formal labor market and a crime sector where individuals can self-select into a particular category of occupation.
- We will fully address an important but unexplored issue which is to differentiate between individual and organized criminal activities and hence to endogenously determine the composition of crimes – in particular, we will allow individual and organized criminals to face different arrest risks, different success rates, different reward structures as well as different outside options.[6]
- We will explicitly model the hierarchical structure and the operation of the criminal organization, highlighting (i) the extent of the operating activeness, (ii) the degree of the monopoly power, and (iii) the relative bargaining strength of the organized criminals working for the mafia.
- We will investigate the various general equilibrium channels through which labor-market conditions and different crime deterrence policies may influence the individual's decision-making and the equilibrium individual and organized criminal activity outcomes, including (i) the

people in their locale, region, or the country as a whole.

[5] For example, the severity of organized crimes has been emphasized in Garoupa (2000). Robinson (1994) also argues that criminal organizations usually attract the most dangerous criminals in society. Recently, Curry and Mongrain (2008) stressed that criminal organizations often use violence to maintain their monopoly power, thereby representing greater threats to potential victims.

[6] Fiorentini and Peltzman (1995) stated that "even if economists may have some comparative advantage in the analysis of organized crime, they have done relatively little work in the area." Polo (1995) also argued that, despite the important policy implications,there has been little economic analysis of organized crimes.

individual's "occupational choice" channel, (ii) the "interdiction" channel that affects the effective risk of being arrested, (iii) the criminal organization's "risk sharing" channel, as well as (iv) the mafia's and the organized criminal's "commission bargaining" channel.

Specifically, we allow individuals to be heterogeneous in their moral costs: they make an occupational choice, determining whether to stay clean by working in the formal labor sector (as workers), or to commit less-serious individual crimes (as individual criminals), or to engage in more-serious organized crimes (as organized criminals or "soldiers" or "crews"). Their dynamic interactions are conveniently modeled using the search-theoretic approach that allows for endogenous matches and entries and hence endogenous victimization and crime success rates, under which we are able to identify four interesting general-equilibrium effects. First, there is a "crime composition effect" driven by the occupational switch within the criminal sector. We will show that, due to this crime composition effect, the population of a particular type of criminal may *rise* in response to a tightened crime deterrence policy. Second, the extent of the occupational switch within the criminal sector is related to the bargaining between the mafia and the potential soldiers that endogenously pins down the mafia's offer of commission to soldiers. While a higher commission encourages an occupational switch to organized crime, a lower commission discourages it. This "commission bargaining effect" crucially depends on the bargaining power and the endogenous outside options facing the mafia and the potential soldiers. Third, our model permits a "positive interdiction effect" in which more searching crews in an active subdivision leads to a greater exposure for the subdivision to be detected and hence a *higher* effective risk. This contrasts with conventional studies on individual and organized crimes in which the likelihood of one agent being detected is independent of that for another. This effect also differs from the negative interdiction effect identified by Sah (1991) whereby, the more criminals there are, the less likely it is that any individual among them will be caught given a fixed level of law enforcement. Fourth, under the hierarchy of the criminal organization, there are two layers of "risk sharing effects". On the one hand, the mafia provides the soldiers with an insurance against police arrests by paying the commission regardless of the arrest. On the other hand, we also allow the criminal organization to create a wall to insulate some of the members by hiding them from being exposed to police detection. As a result, the equilibrium mass of searching crews in each active subdivision is adjusted *adversely* to crime deterrence policies and the resulting reduction in the effective arrest rate *diminishes* the effects of such policies. These four general-equilibrium effects lead to several unconventional comparative-static outcomes that may yield useful policy implications and empirically testable hypotheses.

The main findings of our paper are summarized as follows. First, in forming the criminal organization, a more severe nonpecuniary punishment raises the equilibrium flow commission offered to soldiers, whereas a higher arrest rate has an ambiguous effect that depends on the relative bargaining strength between the mafia and the soldiers. Second, concerning the individual agent's occupational choice under a given victimization rate, an increase in the job finding rate encourages a switch from individual criminals to workers. In addition, a tightened crime deterrence policy of either nonpecuniary punishment or arrest rate type induces a switch from criminals to workers, and a more active operation by the mafia has an ambiguous effect on the occupational choice between the two criminal activities. Third, by calibrating the model economy, our numerical results suggest that, in response to any labor-market, crime-policy and criminal organization changes, the unemployment and the overall crime rates are always positively related, corroborating the empirical facts. Fourth, our numerical analysis also indicates that, depending on the types of changes, the overall crime rate and the ratio of organized to individual criminals may exhibit a positive or a negative relationship. Fifth, our numerical exercises indicate that while both crime deterrence policies have nonnegligible effects on the labor-market outcomes, the nonpecuniary punishment policy is not as effective as the arrest rate policy in overall crime reduction due to risk sharing within criminal organizations. Finally, depending on the measurement, an increase in the mafia's monopoly power may be associated with a smaller or a larger output of crime.

Related Literature

Since the pivotal studies by Becker (1968) and Ehrlich (1973), economists have begun to examine the individual agent's rational choice between legal and illegal activities in the face of different deterrence arrangements. Although the deterrence of organized crimes is perhaps the most prominent criminal policy agenda, the existing research on the economics of crimes has focused primarily on individual rather than organized crimes. As for individual crimes, in the recent literature dynamic general equilibrium frameworks have been used to characterize the individual agent's decision-making as to whether to engage in illegal activities.

In the thin but growing literature on organized crimes, a criminal organization is modeled either as a monopolistic firm (or a non-coordinated group of firms owning some degree of monopoly power) or as a centralized quasi-government. The former branch of the literature is based purely on industrial organization aspects, such as Buchanan (1973), Gambetta and Reuter (1995), and more recently Garoupa (2000). These studies regard criminal activities as "social bads" and conclude that the monopolistic market is considered to be better than a perfectly competitive one, because of its relatively small "output of crime." In the latter branch of the literature, a criminal organization is defined as one competing and/or colluding with the government and among themselves to monopolize a particular market in a given territory (cf. Grossman 1995 and Posner 1998). These criminal organizations are usually regarded as protecting property rights and enforcing contracts when legitimate governments are not well-functioning (cf. Anderson 1995 and Skaperdas and Syropoulos 1995). Additionally, Chang, Lu and Chen (2005) endogenize the size of a criminal organization which in turns affects the optimal law enforcement, whereas Mansour, Marceau, and Mongrain (2006) endogenize the formation of gangs to show that an increase in deterrence can increase crime-market competition and raise the number of competing criminal gangs as well as the total illegal output. By applying the theory of the firm approach to organized crime, Garoupa (2007) models the mafia as the principal and the soldiers as the agents in which the former organizes criminal activities and makes costly investments to reduce the probability of the agents being caught. By focusing exclusively on the output and structure of organized crimes, these studies largely ignore the general-equilibrium interactions between the formal labor market and the crime sector.

In the individual crime literature, economists have recently begun to study the interactions between the socioeconomic environment and the concomitant rate of individual crimes in various general-equilibrium frameworks.[7] İmrohoroğlu, Merlo and Rupert (2004) calibrate a general competitive equilibrium model of crime to explain why property crimes have declined over the past few decades, whereas Lochner (2004) studies the relationship between crimes and labor market outcomes. Within the social network framework, Glaeser, Sacerdote and Scheinkman (1996), Calvó-Armengol and Zenou (2004), Silverman (2004), and Calvó-Armengol, Verdier and Zenou (2007) emphasize the role of social interactions in crimes and investigate how the effectiveness of crime deterrence policies depends on the mode of socialization between agents. A common finding in this literature is the presence of multiple equilibria with the coexistence of a higher-crime equilibrium and a crime-free equilibrium.

In a way that is more closely related to our paper, some recent studies model the interactions between the formal labor market and the crime sector using the search-theoretic approach. Burdett, Lagos and Wright (2003) address the interrelations between crime, inequality, and unemployment, whereas Burdett, Lagos and Wright (2004) revisit this issue by generalizing the model in their earlier work to allow for on-the-job search. By shedding light on the role of human capital, Huang, Laing and Wang (2004) examine the relationships between crime, education and market wages. Engel-

[7] In his survey, Merlo (2001) emphasizes the importance of using a dynamic general-equilibrium framework to model criminal behavior.

hardt, Rocheteau and Rupert (2008) quantitatively study the effects of various labor market and anti-crime policies by extending the conventional search models to allow agents to undertake formal labor and criminal activities simultaneously. All of these studies focus exclusively on individual crimes, leaving organized criminal activities unexplored.

To sum up, the main contribution of our paper is that it models the interactions between legal and illegal activities as well as the individual agent's rational choice between individual and organized criminal activities. In so doing, we are able to explain the different criminal activity outcomes both in terms of the overall crime rate and the composition of crimes. We are also able to explain why conventional labor-market or crime-deterrence policies need not be effective in reducing both the level and the severity of crimes.

2 The Model

We construct a general-equilibrium search and matching model of crime. In addition to the government, the economy is populated by three distinct risk-neutral agents, namely, households, firms and a mafia operating organized crimes.[8] All agents are born and die at a common flow rate, $\delta > 0$, where the dead are replaced by identical new-born. All agents discount the future at a common rate $r > 0$ (inclusive of the death rate).

There are two theaters of economic activities: the formal labor market and the criminal sector, where the latter consists of individual and organized crimes. Every household makes an optimal *occupational choice* between seeking a job in the formal labor market to become a worker and engaging in crimes either individually or under the shelter of the criminal organization. In the formal labor market, job seekers and vacancies are brought together through a stochastic matching technology. A similar matching phenomenon can also be used to describe the criminal activity where a "match" between a criminal and a victim indicates that a crime succeeds.

2.1 Households

All households are identical except for their moral costs with respect to committing crimes. Each household is endowed with an indivisible unit of labor that may be supplied inelastically without disutility from effort. At each point in time, a household may be in one of the two states: an "acquisition state" (seeking goods to hold in inventory and to ultimately consume) and a "consumption state" (seeking to derive utility by consuming goods currently held). The total population of

[8] We use the term mafia generally to consist of the "boss" and all "caporegimes" heading the subdivisions.

households is denoted by $\bar{N}$.

In the acquisition state, a worker augments goods holdings by using her labor endowment (the total mass is denoted as U). By contrast, a criminal augments goods holdings through theft (and through a self-employed job in the case of committing individual crimes). Upon committing an individual crime in the acquisition state, a criminal is by construction an active searcher (the total mass is R^I). Under a criminal organization, however, a soldier may be ordered by the mafia to be active (total mass denoted by R^O) or hidden (total mass denoted by R^H). Hidden criminals in the criminal organization are free from being arrested.

Upon obtaining the fruit of labor (say, a Diamond's (1984) coconut), a worker must wait for a judicious moment to consume and to derive utility (say, not until she reaches a white sand beach). During this waiting period, she may be robbed of her fruit – in this case, she must return to the acquisition state and start the process over again. For simplicity, we assume that all criminals are free from being robbed.[9] We denote the masses of workers, individual criminals and organized criminals in the consumption state as E, Q^I and Q^O, respectively.

Let us denote the total mass of workers as N and the fraction of criminals committing organized crime as Ψ. We can then summarize the division of the population as follows:

Population	Total	Consumption State	Acquisition State
Workers	N	E	U
Individual Criminals	$(1-\Psi)(\bar{N}-N)$	Q^I	R^I
Organized Criminals	$\Psi(\bar{N}-N)$	Q^O	$R^O + R^H$

Accordingly, we have the following three population identities:

$$\begin{aligned} N &= E + U, \\ (\bar{N}-N)(1-\Psi) &= Q^I + R^I, \\ (\bar{N}-N)\Psi &= Q^O + R^O + R^H. \end{aligned} \tag{1}$$

2.2 Firms

The role of firms in the formal sector is relatively passive. Each firm possesses a fixed-coefficient's technology that employs the labor services of one worker at a time and produces an output measured by $y > 0$. To simplify our analysis, the wage offer is determined by a fixed wage rule:

$$w = \xi y \tag{2}$$

[9] We could allow criminals to become victims at a lower victimization rate without changing the main results.

where $0 < \xi < 1$.

2.3 The Criminal Organization

We focus on the hierarchical structure of criminal organizations, in particular the operation of active subdivisions and the determination of soldier commissions.[10] A typical operation of a criminal organization involves avoiding full exposure to law enforcing agents. We model this important feature by assuming that the mafia divides the criminal organization into n subdivisions with m of them being active and $n-m$ of them being inactive (hidden). Imposing symmetry, we have: $R^O = \sum_{k=1}^{m} R_k^O = mR_k^O$; hence, $R^H = \frac{n-m}{m} \cdot R^O$ and $R^O + R^H = \frac{n}{m} R^O$.

Active soldiers in the criminal organization encounter a victim at a flow rate β^O at which he may steal goods w. Let π be the rate at which a particular criminal is caught and $P = 1-(1-\pi)^{R_k^O}$ denote the probability of the police dismantling a subdivision of the criminal organization with R_k^O active crews. Then the overall success rate is calculated as: $\sum_{k=0}^{m} \binom{m}{k} P^k (1-P)^{m-k}(m-k) = 1-P$. As is evident, P is increasing in the strength of law enforcement π.

In the conventional individual and organized crime literature, it is assumed that a criminal's arrest rate is independent of the behavior of others. Sah (1991) assumes instead that each criminal's interdiction rate is lower when more commit crimes. This negative interdiction effect is endogenized by Huang, Laing and Wang (2004) using a general-equilibrium search framework with only individual crime activities. In our organized crime sector, we specifically model the fact that organized crimes are committed by the collaboration of more than one criminal. As a consequence, there exists a *positive interdiction effect* in which more searching crews in an active subdivision leads to a greater exposure for the subdivision to be detected and hence a higher effective risk (i.e., P is increasing in R_k^O). In the presence of this positive interdiction effect, a soldier, by participating in an organized crime, is exposed to a higher arrest rate than an individual criminal ($P > \pi$).

Regardless of their status (active or hidden), all soldiers in the criminal organization are paid by a flow commission of $b > 0$ (to be endogenously determined) at each point-in-time. Let us further denote c and F as the variable and fixed operating costs facing the mafia. We can now specify the

[10] Thus, for simplicity, we are abstracting from the qusai-government aspect of criminal organizations.

mafia's point-in-time surplus as follows:

$$
\begin{aligned}
s &= \left[\sum_{k=0}^{m}\binom{m}{k}P^k(1-P)^{m-k}(m-k)R_k^O\right]\cdot\beta^O w-\sum_{k=1}^{m}cR_k^O-b\cdot\sum_{k=1}^{n}R_k^O-F\\
&= \left[\sum_{k=0}^{m}\binom{m}{k}P^k(1-P)^{m-k}(1-\frac{k}{m})\cdot\beta^O w-c-\frac{nb}{m}\right]R^O-F \qquad (3)\\
&= \left[(1-P)\beta^O w-c-\frac{nb}{m}-\frac{F}{R^O}\right]R^O.
\end{aligned}
$$

2.4 The Government

The government performs two law enforcement functions: arresting and punishing criminals. For simplicity, we assume that punishment is nonpecuniary, in forms of disutility, and that arresting criminals incurs policing costs measured by $\nu\pi$. To balance its budget, the government finances the policing costs by levying a lump-sum tax T on each employed worker. That is, the following government budget constraint must hold:

$$TE = \nu\pi. \qquad (4)$$

2.5 Matching and Population Dynamics

Let μ denote the flow rate at which a worker locates a job in the formal labor market (job finding rate) and η represent the flow rate at which a firm locates a worker (job recruitment rate). Since each job is filled by exactly one worker, it follows that

$$\mu U = \eta V = m_0 M(U,V), \qquad (5)$$

where $m_0 > 0$ and M is the matching technology governing the flow rate of contacts between the two parties; it is strictly increasing, strictly concave and homogeneous of degree one in U and V, satisfying Inada and boundary conditions (i.e., $M(0,V) = M(U,0) = 0$).

Denote by β^I ($< \beta^O$) the flow rate at which an individual criminal encounters a victim and by α the victimization rate at which a worker loses her fruit to a criminal. The "matching" behavior in the criminal sector, including individual and organized crimes, is governed by,

$$\alpha E = \beta^I \cdot R^I + \beta^O \cdot R^O. \qquad (6)$$

That is, the flow crime rate can be measured by either the flow rate at which workers are victimized or the flow rate at which criminals succeed.

At the flow rate μ, workers acquire jobs and move from the acquisition state to the consumption state. Workers exit the consumption state by successfully consuming the fruits of their labor at rate λ, or by death at rate δ, or by becoming the victims of crime at rate α. Thus, the population of workers at the consumption state evolves according to,

$$\dot{E} = \mu U - (\lambda + \delta + \alpha)E, \tag{7}$$

Similarly, individual (resp. organized) criminals enter the consumption state after successfully committing a robbery β^I (resp. β^O) and exit the state Q^I (resp. Q^O) either by consuming λ or by death δ. These considerations yield:

$$\begin{aligned} \dot{Q}^I &= \beta^I R^I - (\lambda + \delta)Q^I, \\ \dot{Q}^O &= \beta^O R^O - (\lambda + \delta)Q^O. \end{aligned} \tag{8}$$

In the steady state, $\dot{E} = \dot{Q}^j = 0$ $(j = I, O)$, which gives the relationships between the populations in the acquisition and the consumption states.

2.6 Asset Values

We turn next to setting up the asset values facing each type of agent. Basically, the flow value achieved by each agent is equal to the instantaneous utility plus the expected incremental value from changing states.

We denote the households' values by J_i, using the subscript i to label the corresponding state: U (searching workers), E (employed workers), R^I (searching individual criminals), Q^I (succeeding individual criminals), R^O (searching organized criminals) and Q^O (succeeding organized criminals). Here, the term "success" refers to successfully robbing a victim rather than escaping from the police.

In the case of workers, the flow values from job search and occupying the consumption state are given by,

$$rJ_U = \mu(J_E - J_U), \tag{9}$$

$$rJ_E = \lambda w - T + (\lambda + \alpha)(J_U - J_E). \tag{10}$$

where a searching worker has no instantaneous utility but an employed worker may enjoy the fruit of her labor at rate λ upon paying the lump-sum tax.

Concerning individual criminals, we note that in addition to what they obtain from committing an individual crime, they can utilize their remaining time to earn self-employed income measured by aw, where their self-employment income to formal-sector wage ratio a is exogenously given. We further denote $\phi^I = (1+a)(1-\pi)$ as the gross rate of return from committing an individual crime and z as the disutility from nonpecuniary punishment. The flow values from committing individual crimes in the acquisition and consumption states can therefore be specified as:

$$rJ_{R^I} = \beta^I(J_{Q^I} - J_{R^I}), \tag{11}$$

$$rJ_{Q^I} = \phi^I \lambda w - \pi z + \lambda(J_{R^I} - J_{Q^I}), \tag{12}$$

Again, a searching individual criminal has no instantaneous utility, whereas a succeeding one receives an expected outcome of $(1-\pi)w$ from committing an individual crime and an expected self-employment income $(1-\pi)aw$ (which can be enjoyed at rate λ) but may suffer a loss if he is caught (the expected disutility is captured by πz).

In contrast with individual crimes, being a soldier in a criminal organization is a full-time job regardless of the current status (active or hidden). By successfully robbing a victim, a soldier receives a flow commission b where the commission is paid even if he is caught. That is, there is a *risk sharing effect*: the mafia provides the soldiers with an insurance against police arrests by paying the commission regardless of the arrest. Recall that, by committing an organized crime, a soldier is exposed to a higher arrest rate than an individual criminal ($P > \pi$). However, since hidden criminals in the criminal organization do not have to face being arrested, the arrest rate facing each soldier decreases with the number of active subdivisions and the mass of active crews. Thus, as the equilibrium mass of searching crews in each active subdivision is adjusted in the opposite direction to the crime deterrence policies, there is another type of *risk sharing effect* that occurs via the endogenous reduction in the equilibrium arrest rate in organized crimes. The presence of these two *risk sharing effects* is an important feature observed in organized crimes.

By being caught, a soldier will suffer a higher nonpecuniary punishment than an individual criminal, where the incremental punishment is measured by σz, $\sigma > 0$.[11] Thus, the flow values of an organized criminal in the acquisition and consumption states are, respectively,

$$rJ_{R^O} = \beta^O(J_{Q^O} - J_{R^O}), \tag{13}$$

$$rJ_{Q^O} = \phi^O \lambda w - P(1+\sigma)z + \lambda(J_{R^O} - J_{Q^O}), \tag{14}$$

where the gross return is simply: $\phi^O = b$.

Let Π_F and Π_V denote the firms' filled and vacant values, respectively. Upon paying the wage to the matched worker, a firm gains an instantaneous profit of $y - w$. Thus, its flow unfilled value

[11] As stressed by Garoupa (2000), members of criminal organizations usually face a more severe punishment because they signal their larger damage to a society and their higher likelihood of repeating offenses.

and its filled value are given by,

$$r\Pi_V = \eta(\Pi_F - \Pi_V), \tag{15}$$

$$\Pi_F = y - w + \Pi_V = (1-\xi)y + \Pi_V. \tag{16}$$

Finally, we denote the mafia's value and outside option as Π_M and $\underline{\Pi}$, respectively. The mafia's incremental value must equal the point-in-time surplus:

$$\Pi_M = s + \underline{\Pi}. \tag{17}$$

For simplicity, we assume that the mafia's outside option, $\underline{\Pi}$, is exogenously given.

3 Bargaining and Occupational Choice

In this section, we solve the flow commission under organized crimes and then determine the households' occupational choice.

3.1 Flow Commission to Organized Criminals

The flow commission to organized criminals is assumed to be determined by a bargain between the mafia and his soldiers to maximize their joint surpluses:[12]

$$\max_b \sum = (\Pi_M - \underline{\Pi})^\gamma (J_{R^O} - J_{R^I})^{1-\gamma}. \tag{18}$$

While $\Pi_M - \underline{\Pi}$ measures the surplus for the mafia to operate the criminal organization, $J_{R^O} - J_{R^I}$ represents the surplus accrued by a soldier facing an outside option of committing an individual crime. The weighting parameter $\gamma \in (0,1)$ indicates the relative bargaining strength of the mafia, which also captures the "monopoly power" of the mafia in the criminal sector.

Denote $b_{\min}$ as the lowest commission for a potential organized criminal to serve as a soldier for the mafia and $b_{\max}$ as the highest commission that the mafia is willing to offer. We impose:

Assumption 1. (Active Organized Crime Participation) $\Pi_M > \underline{\Pi}$ and $J_{R^O} > J_{R^I}$.

This assumption implies that both the mafia and potential organized criminals are actively participating. This is assumed throughout because organized crimes are the focus of our paper. Under

[12] A recent paper by Engelhardt, Rocheteau and Rupert (2008) models the "network" between drug wholesalers and retailers; where the two parties bargain over the surplus from engaging criminal activities jointly. The bargaining structure of the mafia in our paper follows the same spirits.

Assumption 1, it is readily verified that $b_{\max} > b_{\min}$ and hence the bargaining set is nonempty. We can express this as follows:

Proposition 1. (Flow Commission to Organized Criminals) *Under Nash bargaining, the flow commission to organized criminals is given by,*

$$b^* = \gamma b_{\min} + (1-\gamma) b_{\max}, \tag{19}$$

where $b_{\min} = \phi^I \frac{\beta^I(r+\lambda+\beta^O)}{\beta^O(r+\lambda+\beta^I)} + \left[\frac{P(1+\sigma)}{\pi} - \frac{\beta^I(r+\lambda+\beta^O)}{\beta^O(r+\lambda+\beta^I)}\right] \frac{\pi z}{\lambda w}$ *and* $b_{\max} = \frac{m}{n}\left[(1-P)\beta^O w - c - \frac{F}{R^O}\right]$.

Proof: All proofs are relegated to the Appendix.

When the mafia's relative bargaining strength (γ) is the highest, the solution $b^* = b_{\min}$ is essentially one with the mafia making a take-it-or-leave-it offer to the potential criminal, pinning the latter down at his lowest option value. When the potential organized criminal faces a relative higher arrest rate (a higher $\frac{P}{\pi}$) or a relatively more severe punishment (a larger σ), he must demand a sweeter commission, thereby implying a higher value of $b_{\min}$. A similar situation arises when the potential organized criminal faces a higher outside option value, due either to a greater gross return from committing an individual crime (a higher ϕ^I) or to a higher effective rate of realizing the return (a larger $\frac{\beta^I/(r+\lambda+\beta^I)}{\beta^O/(r+\lambda+\beta^O)}$). Moreover, when the mafia incurs a larger gain from operating the criminal organization, he is more willing to offer a greater commission to the potential criminal, i.e., $b_{\max}$ is higher. On the contrary, when the criminal organization is operated with a smaller number of active subdivisions, the mafia is less willing to offer a sweeter commission.

Next, we study how the bargaining outcome responds to changes in crime deterrence policies.

Proposition 2. (Characterizing Flow Commission to Organized Criminals) *Under Nash bargaining, the flow commission to organized criminals possesses the following properties:*

(i) *a more severe nonpecuniary punishment raises the lowest commission for a potential organized criminal to serve as a soldier and the equilibrium flow commission*;

(ii) *a higher arrest rate raises the lowest commission for a potential organized criminal to serve as a soldier but reduces the highest commission that the mafia is willing to offer, leading to an ambiguous effect on the equilibrium flow commission.*

Intuitively, it is the potential organized criminal who bears the cost of nonpecuniary punishment (z). Thus, a more severe nonpecuniary punishment requires that a sweeter commission be offered to the potential organized criminal. On the contrary, a higher arrest rate (π) harms both the mafia and the soldier, thereby shrinking the bargaining set. It is thus possible to have a lower commission if the mafia is more responsive to this crime deterrence policy. As we will see, this *commission bargaining effect* is crucial for the households' occupational choice and the effectiveness of crime deterrence policies.

3.2 Occupational Choice

Households are heterogeneous only in their moral costs with respect to committing crimes, in terms of their disutility. We capture this heterogeneity by d, where d is uniformly distributed over [0, 1]. The moral cost born by a type-d household is then specified as: $q^j \cdot d$ ($j = O, I$) with $q^O > q^I$, which indicates that committing organized crimes leads to stronger moral condemnation than committing individual crimes. A household's type is entirely private information, which cannot be verified or used to alter the bargaining outcome. It, however, plays a crucial role in determining the household's occupational choice.

Specifically, by taking moral costs into account, we redefine the corresponding values and utilize (9)-(14) to obtain the following net asset values:

$$\begin{aligned} \tilde{J}_U(d) &= J_U = \tfrac{\mu(\lambda w - T)}{r(r+\lambda+\mu+\alpha)}, \\ \tilde{J}_{R^I}(d) &= J_{R^I} - q^I \cdot d = \tfrac{\beta^I(\phi^I \lambda w - \pi z)}{r(r+\lambda+\beta^I)} - q^I \cdot d, \\ \tilde{J}_{R^O}(d) &= J_{R^O} - q^O \cdot d = \tfrac{\beta^O[b^* \lambda w - P(1+\sigma)z]}{r(r+\lambda+\beta^O)} - q^O \cdot d. \end{aligned} \tag{20}$$

These net values are plotted against the households' types d (see Figure 1). It is obvious that while $\tilde{J}_U(d)$ is independent of d, $\tilde{J}_{R^I}(d)$ and $\tilde{J}_{R^O}(d)$ are decreasing in d with the latter steeper than the former (since $q^O > q^I$). There are two important critical points: one denoted by d_1 satisfying $\tilde{J}_{R^O}(d) = \tilde{J}_{R^I}(d)$ and another denoted by d_2 satisfying $\tilde{J}_{R^I}(d) = \tilde{J}_U(d)$ (corresponding to points A and B, respectively, in Figure 1).

From (20), we obtain:

$$d_1 = \frac{1}{q^O - q^I} \cdot \left\{ \frac{\beta^O[b^* \lambda w - P(1+\sigma)z]}{r(r+\lambda+\beta^O)} - \frac{\beta^I(\phi^I \lambda w - \pi z)}{r(r+\lambda+\beta^I)} \right\}, \tag{21}$$

$$d_2 = \frac{1}{q^I} \left[\frac{\beta^I(\phi^I \lambda w - \pi z)}{r(r+\lambda+\beta^I)} - \frac{\mu(\lambda w - T)}{r(r+\lambda+\mu+\alpha)} \right]. \tag{22}$$

Clearly, we must have $d_1 < 1$ and $d_2 < 1$, since otherwise there will be no workers and criminals will have nothing to steal. We will rule out the case with $d_2 < 0$ under which no one commits crimes. Moreover, we have:

Lemma 1. *Under Assumption 1, $d_1 > 0$.*

This lemma implies that there is always a positive measure of households choosing to commit organized crimes.

Thus, we are left with two cases: (i) $d_1 < d_2$ where organized criminals, individual criminals and workers all coexist (Figure 1a) and (ii) $d_1 > d_2$ where organized criminals and workers coexist but there are no individual criminals (Figure 1b). Defining $a_q = \frac{-q^I}{q^O - q^I} < 0$ and $\hat{b} = \frac{\mu(r+\lambda+\beta^O)(1-T/\lambda w)}{\beta^O(r+\lambda+\mu+\alpha)} + \frac{P(1+\sigma)z}{\lambda w}$, we can now characterize these two occupational choice patterns as follows:

Proposition 3. (Occupational Choice) *Under Assumption 1, the households' occupational choice possesses the following properties:*

(i) Case I: *If $[1-(1-\gamma)a_q]b_{\min} + (1-\gamma)a_q b_{\max} > \hat{b}$, then households with $d \in [0, d_1)$ choose to commit organized crimes, those with $d \in [d_1, d_2)$ choose to commit individual crimes, and those with $d \in [d_2, 1]$ choose to work in the formal labor market.*

(ii) Case II: *If $[1-(1-\gamma)a_q]b_{\min} + (1-\gamma)a_q b_{\max} < \hat{b}$, then households with $d \in [0, d_2)$ choose to commit organized crimes and those with $d \in [d_2, 1]$ choose to work in the formal labor market.*

Using (21) and (22) and referring to Figure 1, we can further derive the *fraction* of population of each "occupation", organized criminals (O), individual criminals (I) and workers (W), as:

$$O = \frac{(n/m)R^O}{U + R^I + (n/m)R^O} = d_1, \tag{23}$$

$$I = \frac{R^I}{U + R^I + (n/m)R^O} = d_2 - d_1 \equiv \Delta d_2, \tag{24}$$

$$W = \frac{U}{U + R^I + (n/m)R^O} = 1 - d_2. \tag{25}$$

This completes the determination of the steady-state equilibrium with exogenous victimization (i.e., by regarding α, and hence the *level* of each relevant criminal population, as given).

3.3 Characterizing the Steady-State Equilibrium with Exogenous Victimization

At this stage we can perform some interesting comparative statics with exogenous victimization by characterizing the households' occupational choice. Given the equilibrium commission b^* determined by the Nash bargain, we can study how the equilibrium proportion of each occupation responds to labor-market conditions, crime deterrence policies and the structure of the criminal organization.

Unless referred to otherwise, we focus only on the general case where all three occupations coexist (i.e., Case I).

Proposition 4. (Effects of a Higher Job Finding Rate) *Under Assumption 1 with exogenous victimization, an increase in the job finding rate encourages a switch from individual criminals to workers without changing the proportion of organized criminals.*

As indicated in Figure 2a, an improved formal labor market condition raises the worker's net value, thereby inducing marginal individual criminals to switch to the formal sector (the critical point B shifts to B'). Because it does not affect the relative payoff between committing an individual and committing an organized crime, the population of organized criminals remains unchanged. Should such an improvement continue, all individual criminals will switch to the formal sector and, afterward, some organized criminals will begin to move out to join the formal labor market (as indicated by the critical point B''). An interesting, empirically testable implication is that organized criminal activities are less responsive to formal labor market conditions than individual criminal activities.

Proposition 5. (Effects of Tightened Crime Deterrence) *Under Assumption 1 with exogenous victimization,*

(i) (effect on workers) *a tightened crime deterrence policy of either type always induces a switch from criminals to workers;*

(ii) (effect on organized criminals) *while a more severe nonpecuniary punishment always reduces the proportion of organized criminals, a higher arrest rate generates a similar effect if it increases the effective arrest rate facing organized criminals more than proportionately (i.e.,* $\frac{\partial P}{\partial \pi}\frac{\pi}{P} > 1$*);*

(iii) (effect on individual criminals)

a. *when the moral cost differential is sufficiently high (resp. low), a tightened crime deterrence policy of either type decreases (resp. increases) the proportion of individual criminals;*

b. *when the moral cost differential is moderate, a more severe nonpecuniary punishment lowers the proportion of individual criminals but a higher arrest rate raises it.*

Either crime deterrence policy lowers the net values of both types of criminals (so the critical points shift from A and B, respectively, to A' and B' in Figure 2b). It is therefore not surprising that there is an occupational switch from the criminal sector to the formal labor market. Because a more severe nonpecuniary punishment penalizes organized criminals more than individual criminals, the proportion of the former population is unambiguously lower. In the case of a higher arrest rate, the effect is less clear-cut, but a similar negative effect arises if a higher arrest rate punishes organized criminals more. Concerning the proportion of individual criminals, the net effects of these crime deterrence policies depend crucially on the outflow to the worker pool versus the inflow from the organized criminal pool. Should the moral cost differential be sufficiently large, the occupational switch from organized to individual criminals is moderate. One may thus expect a net reduction in the proportion of individual criminals in response to a tightened crime deterrence policy. As indicated in Proposition 2, a more severe nonpecuniary punishment always raises the commission offered to potential organized criminals (a positive commission bargaining effect), but a higher arrest rate may lower the commission. Thus, the occupational switch from organized to individual criminals is more responsive to the arrest policy and the proportion of individual criminals may increase with intermediate moral cost differential under which the net effect of nonpecuniary punishment on the proportion of individual criminals is still negative. The possibility of a positive effect on some type of criminals of a tightened crime deterrence policy is new to the existing literature. This possibility is mainly due to the *crime composition effect* resulting from an occupational switch *within* the criminal sector, which is entirely ignored in previous studies.

Proposition 6. (Effects of Increasing the Mafia's Monopoly Power or Operating Activeness) *Under Assumption 1 with exogenous victimization,*

(i) *an increase in the mafia's monopoly power induces a switch from organized criminals to individual criminals, but leaves the proportion of workers unchanged;*

(ii) *a more active operation by the mafia has no effect on the proportion of workers and an ambiguous effect on the occupational choice between the two criminal activities.*

This proposition suggests that, with exogenous victimization, changes in the structure of the criminal organization only reallocate the population between individual and organized criminal activities, without affecting the total proportion of criminals nor the economy-wide crime rate. When the mafia's monopoly power is strengthened (a higher γ), the soldiers are offered lower commissions and the organized criminal's net value is reduced (see Figure 2c where the critical point A shifts to A'). As a consequence, those with relatively higher moral costs switch to individual crimes. When the mafia operates the criminal organization more actively by ordering more subdivisions to plunder goods (a higher m), the potential profit is higher and the effective risk is lower due to a positive interdiction effect caused by a reduction in the mass of active crews in each subdivision for a given mass of total searching soldiers (R^O). While the increased potential profit raises $b_{\max}$, the reduced effective arrest rate facing organized criminals decreases $b_{\min}$. Should the former dominate (indicated by a shift in the critical point from A to A'), a higher commission will be awarded to the soldiers, thereby encouraging more criminals to commit organized crimes. If the opposite is true (indicated by a shift in the critical point from A to A''), criminals are reallocated to the individual crime sector.

4 Endogenous Matching

After characterizing the most essential element of our model, namely, occupational choice, we next turn to examining the steady-state equilibrium of the general framework with the victimization rate, and hence the level of each relevant criminal population, endogenously determined.

4.1 Steady-State Equilibrium with Endogenous Victimization

Apparently, when endogenizing matching, it becomes difficult (if not impossible) to analytically characterize the steady-state equilibrium. Thus, our main task is to show how the steady-state equilibrium is determined, while performing the comparative-static exercises numerically.

More specifically, in the general framework with endogenous victimization, we must pin down the victimization rate α^* as well as a tuple of population masses $\{N^*$, E^*, U^*, Ψ^*, Q^{I^*}, R^{I^*}, Q^{O^*}, $R^{O^*}\}$, using (1), (6)-(8), (23) and (24). This can be done in two steps. To begin with, we express (N, E, U, Ψ, Q^I, R^I, Q^O) as a function of (R^O, α). We then establish two fundamental relationships to determine (R^O, α) jointly.

Consider,

Assumption 2. $(m/n)\beta^O > \beta^I$.

This assumption implies that the effective rate for an organized criminal encountering a victim ($(m/n)\beta^O$) is larger than one facing an individual criminal (β^I). This is justified in practice because of the provision of information by the criminal organization.

We can show:

Lemma 2. *Under Assumptions 1 and 2, we have the following properties:*

(i) $\frac{\partial N}{\partial \alpha} < 0$, $\frac{\partial E}{\partial \alpha} < 0$, $\frac{\partial U}{\partial \alpha} < 0$, $\frac{\partial \Psi}{\partial \alpha} < 0$, $\frac{\partial Q^I}{\partial \alpha} > 0$, $\frac{\partial R^I}{\partial \alpha} > 0$, $\frac{\partial Q^O}{\partial \alpha} = 0$;

(ii) $\frac{\partial N}{\partial R^O} > 0$, $\frac{\partial E}{\partial R^O} > 0$, $\frac{\partial U}{\partial R^O} > 0$, $\frac{\partial \Psi}{\partial R^O} > 0$, $\frac{\partial Q^I}{\partial R^O} < 0$, $\frac{\partial R^I}{\partial R^O} < 0$, $\frac{\partial Q^O}{\partial R^O} > 0$.

It is evident from (7) and (8) that changes in the victimization rate (α) will not affect steady-state population ratios in either criminal market (individual crime $\frac{Q^I}{R^I}$ and organized crime $\frac{Q^O}{R^O}$). It is immediately clear that, for a given R^O, the victimization rate has no direct effect on the population of organized criminals in the consumption state (Q^O). In response to a higher victimization rate, the expected gain in the individual criminal sector is higher whereas that in the formal labor market is lower. It is therefore not surprising to anticipate a rise in the populations of searching and succeeding individual criminals (R^I and Q^I) as well as a reduction in the populations of searching and employed workers (U and E). Since the effective rate for an organized criminal encountering a victim is larger than one facing an individual criminal (Assumption 2), an increase in active soldiers in the criminal organization (R^O) crowds out individual criminals more than one-to-one, thereby causing some individual criminals with relatively high moral costs to switch to the formal labor market. As a result, the populations of searching and succeeding individual criminals decrease while the populations of searching and employed workers increase.

From Proposition 1, we can see that b^* (and, accordingly, d_1) is a function of R^O alone, independent of α. Using this property and (4), we can rewrite (23) and (24)) to obtain:

$$\begin{aligned} &\tfrac{nR^O}{mU(R^O,\alpha)+mR^I(R^O,\alpha)+nR^O} \\ &= d_1(R^O) \equiv \tfrac{1}{r(q^O-q^I)} \cdot \left\{ \tfrac{\beta^O[b^*(R^O)\lambda w - P(R^O)(1+\sigma)z]}{r+\lambda+\beta^O} - \tfrac{\beta^I(\phi^I \lambda w - \pi z)}{r+\lambda+\beta^I} \right\}, \end{aligned} \tag{26}$$

$$\begin{aligned} &\tfrac{mR^I(R^O,\alpha)}{mU(R^O,\alpha)+mR^I(R^O,\alpha)+nR^O} = \Delta d_2(R^O,\alpha) \\ &\equiv (\tfrac{1}{q^I} + \tfrac{1}{q^O-q^I}) \tfrac{\beta^I(\phi^I\lambda w-\pi z)}{r(r+\lambda+\beta^I)} - \tfrac{1}{q^I}\tfrac{\mu(\lambda w - T)}{r(r+\lambda+\mu+\alpha)} - \tfrac{1}{q^O-q^I}\tfrac{\beta^O[b^*(R^O)\lambda w - P(R^O)(1+\sigma)z]}{r(r+\lambda+\beta^O)}. \end{aligned} \tag{27}$$

Equations (26) and (27) represent the two occupational choice indifference boundaries in (R^O, α) space: one between the two criminal activities (denoted by OC^{IO}) and another between individual crimes and formal employment (denoted by OC^{IW}). These indifference boundaries allow us to solve R^{O^*} and α^* recursively. Once R^{O^*} and α^* are determined, the other endogenous variables (N^*, Ψ^*, E^*, U^*, Q^{I^*}, R^{I^*}, Q^{O^*}) can also be pinned down accordingly.

By defining $\Omega^1 \equiv \frac{nR^O}{mU+mR^I+nR^O} - d_1$ and $\Omega^2 \equiv \frac{nR^I}{mU+mR^I+nR^O} - \Delta d_2$, the slopes of the OC^{IO} and the OC^{IW} loci are given by:

$$\left.\frac{d\alpha}{dR^O}\right|_{OC^{IO}} = -\frac{\Omega^1_{R^O}}{\Omega^1_\alpha} \quad \text{and} \quad \left.\frac{d\alpha}{dR^O}\right|_{OC^{IW}} = -\frac{\Omega^2_{R^O}}{\Omega^2_\alpha}.$$

We impose two regularity conditions: (i) the mafia's willingness to offer commission is decreasing in R^O and (ii) the indirect tax revenue effect is not too strong. A higher R^O increases the criminal organization's exposure to law enforcement, leading to a greater effective arrest rate as well as a lower per soldier fixed cost. When the former effect dominates, the mafia's incentive to offer commission is lower, which we assume throughout the remainder of the paper. In general equilibrium, higher arrest rates create a positive tax revenue effect. Such indirect effects may lead to counter-intuitive outcomes and are therefore assumed to be dominated by the corresponding direct effects. Under these conditions, we can show that the occupational choice indifference boundary between the two criminal activities (OC^{IO}) is upward-sloping in $\left(R^O, \alpha\right)$ space. We further impose a "normality" condition to ensure that a better labor market condition leads to less criminal activities. This normality condition, under a positively sloped OC^{IO} locus, requires that the occupational choice indifference boundary between individual crimes and formal employment (OC^{IW}) be also upward-sloping but flatter than the OC^{IO} locus. Thus, we have:

Lemma 3. *Under Assumptions 1 and 2 and the aforementioned regularity and normality conditions, both the OC^{IO} and OC^{IW} loci are upward sloping with the former steeper than the latter, i.e., $0 < \frac{d\alpha}{dR^O}\big|_{OC^{IW}} < \frac{d\alpha}{dR^O}\big|_{OC^{IO}}$.*

This is depicted in Figure 3. To illustrate this intuitively, we focus on the primary effects. In response to an increase in R^O, both organized and individual criminals face stingier competition and hence a lower success rate. To maintain indifference in their occupational choice, it is therefore necessary for the victimization rate to be higher, implying positively sloped relationships. Since the competition facing organized criminals is more direct, one may thus expect the victimization rate to increase by more in order to compensate for their losses. As a consequence, the OC^{IO} locus is steeper than the OC^{IW} locus.

Denote $\underline{\alpha}$ as the the minimum level of the victimization rate α that ensures a nondegenerate population of criminals. Consider,

Assumption 3. $\lim_{R^O \to 0} \Delta d_2(R^O, \underline{\alpha}) > \frac{\mu\underline{\alpha}}{(\lambda+\delta+\underline{\alpha})\beta^I + \mu\underline{\alpha}}$.

Using Lemma 3, we can establish:

Proposition 7. (Existence of a Steady-State Equilibrium) *Under Assumptions 1-3 and the aforementioned regularity and normality conditions, a unique steady-state equilibrium with an endogenous victimization exists and features nondegenerate criminal activities.*

Since the steady-state equilibrium with endogenous victimization is too complicated to characterize analytically, we will instead perform a numerical analysis to which we now turn.

4.2 Calibration

In the absence of empirical observations of key individual and organized criminal activities, we cannot fully calibrate the model to fit the underlying economy. Instead, we parametrize the model to yield reasonable outcomes. The Values of Parameters in the Benchmark are summarized in Table 1.

Set the total population of the model economy as $\bar{N} = 1000$. Consider a case where labor market conditions are sufficiently poor and criminals are sufficiently active, such as in some inner city areas in the U.S. In this economy, 70% of the population are in the formal labor market, where 20% of them are unemployed; additionally, 15% are in the individual crime market and the remaining 15% are in the organized crime market. Thus, we have: $N = 700$, $U = 140$, $E = N - U = 560$, $\Psi = 1/2$, $(\bar{N} - N)(1 - \Psi) = 150$, $(\bar{N} - N)\Psi = 150$ and the unemployment rate is 20%. Let the ratio of active subdivisions in the criminal organization be $m/n = 15/20 = 3/4$ and the fraction of individual criminals in the acquisition state be 1/3. Moreover, set the ratio of individual criminals in the acquisition state to active soldiers in the criminal organization as 2. We can then compute the composition of criminals as follows: $R^I = 50$, $Q^I = 100$, $R^O = 25$, $R^H = \left(\frac{n-m}{m}\right) R^O = 8.3333$, and $Q^O = (\bar{N} - N)\Psi - \frac{n}{m} R^O = 116.6667$.

Let the rate at which workers exit the consumption state by successfully consuming the fruits of their labor be $\lambda = 1\%$. Since our measure of the overall discount rate includes the death rate, we set it at an adequately high level: $r = 14\%$, where 1% of the overall discounting is assumed to be a result of subjective discounting and hence $\delta = 13.86\%$. The death rate is chosen to produce a sufficiently long unemployment spell (to be discussed below). In the steady state, $\dot{Q}^I = \dot{Q}^O = 0$, so we can use (8) to calibrate:

$$\beta^I = \frac{(\lambda + \delta)Q^I}{R^I} = 0.2972 \text{ and } \beta^O = \frac{(\lambda + \delta)Q^O}{R^O} = 0.6935.$$

That is, the effective rate for an organized criminal to encounter a victim ($(m/n)\beta^O = 0.5201$) is 75% higher than one facing an individual criminal (β^I). Similarly, we can apply (6) and (7) with $\dot{E} = 0$ to obtain:

$$\alpha = \frac{(\lambda + \delta)(Q^I + Q^O)}{E} = 0.0575 \text{ and } \mu = \frac{(\lambda + \delta + \alpha)E}{U} = 0.8244.$$

It should be noted that our computed victimization rate of 5.75% is reasonable. Moreover, from our job finding rate, we can compute the unemployment spell as being $\frac{1}{1-(1-\mu)^{1/12}} = 7.4$ months, which is more than three times longer than the observed average value in the U.S. of 2.2 months as reported in Shimer (2005). This reflects a sufficiently poor labor-market condition that leads to very active criminal activities. Following Shimer (2005), we set $\eta = \mu = 0.8244$, under which the ratio of searching workers to job vacancies becomes one (i.e., $U/V = 1$ and hence $V = 140$).

To ensure nonnegative values, we appropriately choose output per firm as $y = 12$. The labor income share is set at the common value $\xi = 2/3$ and hence $w = 8$. We further select the ratio of the individual criminal's self-employed income to the formal-sector wage as $a = 0.45$. Next, by letting the arrest rate of an individual criminal be $\pi = 10\%$, we can then compute the arrest rate of organized criminals as $P = 16.1\%$. Total arrests can thus be calculated: $\pi R^I + PR^O = 9.0262$. We now choose $\nu = 350$ such that the policing cost per arrested criminal is about half of the individual wage income (precisely, $\frac{\nu\pi}{\pi R^I + PR^O} = 3.88$). Accordingly, the per capita lump-sum tax levied on each worker becomes: $T = \nu\pi/E = 0.0625$.

To ensure adequate occupational choice, we set the moral cost parameters at $q_I = 0.9$ and $q_O = 1.2$. From (22), we can calculate the nonpecuniary punishment parameter on individual criminals as follows:

$$z = \left\{ \phi^I \lambda w - \frac{r + \lambda + \beta^I}{\beta^I} \left[\frac{\mu(\lambda w - T)}{r + \lambda + \mu + \alpha} + r q^I d_2 \right] \right\} \frac{1}{\pi} = 0.1262.$$

Let such punishment of organized criminals be doubled, i.e., $\sigma = 1$. We then assume that the mafia's bargaining strength is three times as high as that of the soldiers, implying that $\gamma = 0.75$. Finally, we choose an adequate fixed cost for operating the criminal organization $F = 10$, which together with the assumed bargaining weight yields reasonable profits incurred by the mafia and reasonable commission to soldiers ($b^* w$). Specifically, we substitute (19), (21) and (22) into (23) and (24) to compute the variable cost parameter:

$$\begin{aligned} c &= (1 - P)\beta^O w - \frac{F}{R^O} + \frac{n\gamma}{m(1-\gamma)} b_{\min} - \frac{n(r + \lambda + \beta^O)}{m(1-\gamma)\lambda w \beta^O} A - \frac{nP(1+\sigma)z}{(1-\gamma)m\lambda w} = 1.8321, \\ b^* &= \gamma b_{\min} + (1-\gamma) b_{\max} = 1.5307, \end{aligned}$$

where

$$A \equiv \frac{\mu(\lambda w - T)}{r + \lambda + \mu + \alpha} + r \cdot \frac{q^O n R^O + q^I m R^I}{mU + mR^I + nR^O}.$$

Thus, by taking a risk serving as a soldier, an organized criminal earns a commission that is a bit more than 50% of the formal-sector wage. These values can be plugged into (21) and (22) to yield: $d_1 = 0.1493$ and $d_2 = 0.3731$.

Using the parameters outlined above, we can calculate the respective asset values of households in the acquisition state, $J_U = 0.0999$, $J_{R^I} = 0.4357$ and $J_{R^O} = 0.4805$, as well as those in the consumption state, $J_E = 0.1168$, $J_{Q^I} = 0.6409$ and $J_{Q^O} = 0.5775$. While the surplus accrued by a filled vacancy in the formal sector is $\Pi_F - \Pi_V = y - w = 4$, the surplus accrued by the mafia is $s = \Pi_M - \underline{\Pi} = 9.5308$, which is more than double the surplus of a formal-sector firm.

4.2.1 Quantitative Comparative-Static Results

By using the selected and calibrated parameters, we now turn to examining how the steady-state equilibrium with endogenous victimization responds to labor-market conditions, crime deterrence policies and the structure of the criminal organization. We focus on the responses of (i) the employment rate ($E/\bar{N}$) and the worker's victimization rate (α), (ii) the mafia's surplus (s), the organized criminal's commission (b^*) and the probability of dismantling a subdivision of the criminal organization (P), (iii) the overall crime rate ($(\bar{N} - N)/\bar{N}$), the composition of crimes measured by the ratio of organized to individual criminals ($\Psi/(1-\Psi)$) and the masses of criminals (R^O, Q^O, R^I, and Q^I). The results are reported in Table 2.

Result 1. (Effects of a Higher Job Finding Rate) *Under Assumptions 1-3, an increase in the job finding rate raises the employment rate and reduces the victimization rate and the masses of individual and organized criminals in both states. While the overall crime rate is lowered, the ratio of organized to individual criminals is higher. Moreover, the mafia's surplus increases, whereas the probability of dismantling a subdivision and the organized criminal's commission decrease.*

Intuitively, an improved labor market condition as a result of a higher job finding rate (μ) enhances job matches and lowers an individual's incentives to commit crimes. Thus, the employment rate increases and the populations of individual and organized criminal populations in both the acquisition and consumption states decrease, leading to a lower overall crime rate. With a thicker labor market, each worker's victimization rate is also reduced. As a result of a lower mass of organized criminals in the acquisition state (R^O), the probability of dismantling a subdivision is also lower. This provides a buffer for organized criminals to escape from law enforcement, thereby causing the composition of crime to change from individual to organized criminal activities. The reduction in the effective arrest rate facing organized criminals expands the bargaining set ($b_{\min}$ falls and $b_{\max}$ rises). Under our parametrization, the monopoly power of the mafia is sufficiently strong so that the equilibrium commission decreases and the mafia's surplus increases.

Result 2. (Effects of Tightened Crime Deterrence) *Under Assumptions 1-3, a tightened crime deterrence policy of either type increases the employment rate and decreases the victimization rate, the masses of individual and organized criminals, the overall crime rate, the mafia's surplus, and the ratio of organized to individual criminals. While a higher nonpecuniary punishment reduces the* *probability of dismantling a subdivision and raises the commission to soldiers, a higher arrest rate leads to the opposite outcome.*

It is not surprising that a tightened crime deterrence policy of either type suppresses criminal activities and encourages labor market activities. However, the two policy instruments have very distinct effects on the probability of dismantling a subdivision: an increase in the arrest rate (π) also raises the effective arrest rate facing organized criminals (P), while an increase in the nonpecuniary punishment (z) decreases the mass of organized criminals in the acquisition state and hence lowers P. The reduction in P can also be viewed as a result of the risk sharing effect of the criminal organization, which subsequently diminishes the effectiveness of the nonpecuniary punishment policy. Moreover, Proposition 2 indicates that while a more severe nonpecuniary punishment raises the equilibrium commission to soldiers which is also a consequence of risk sharing, a higher arrest rate has an ambiguous effect on b^*. This ambiguity is due to the fact that a higher arrest rate shrinks the bargaining set ($b_{\min}$ rises and $b_{\max}$ falls). In our benchmark parametrization where the monopoly power of the mafia is sufficiently strong, the equilibrium commission is thus lower.

Two remarks deserve our attention. First, given the presence of the risk-sharing effect stated above, the nonpecuniary punishment policy is not as effective as the arrest rate policy in reducing the overall crime rate. As shown in Figure 4, the marginal effect of z is much less than that of π: a 1% increase in z results in about 0.3% of the overall crime rate, whereas a 1% increase in π reduces the overall crime rate by about 0.6%. As for the composition of crimes, the nonpecuniary punishment policy is also not as effective as the arrest rate policy in discouraging the more serious type of crimes (i.e., organized crimes). Indeed, the relative difference in the two marginal effects on the composition of crimes is even more substantive than that in relation to the overall crime. Second, by a quantitative experiment, Engelhardt, Rocheteau and Rupert (2008) find that while crime deterrence policies have strong effects on criminal activities, they have virtually no effect on the labor-market outcomes. In contrast, our numerical exercises indicate a nonnegligible effect of either policy: a 5% increase in the arrest rate raises the employment rate by about 1.45% whereas a 5% increase in the nonpecuniary punishment increases the employment rate by about 0.73%.

Result 3. (Effects of Increasing the Mafia's Monopoly Power) *Under Assumptions 1-3, an increase in the mafia's monopoly power increases the employment rate and the masses of individual criminals in both states, while reducing the victimization rate, the masses of organized criminals in both states, the overall crime rate and the ratio of organized to individual criminals. Moreover, it decreases the probability of dismantling a subdivision and the equilibrium commission to soldiers, but increases* *the mafia's surplus.*

Proposition 6 indicates that, for a given victimization rate, the direct effect of an increase in the mafia's monopoly power (γ) results in a rise in the mafia's surplus and a decrease in the bargained commission to soldiers. This negative commission bargaining effect induces an occupational switch from organized to individual crimes without affecting either the total proportion of criminals or the mass of workers. In general equilibrium, such an occupational switch leads to tougher competition in the individual crime market, thereby causing some with relatively higher moral costs to switch to the formal labor market. Thus, the overall crime rate is lower, the employment rate is higher, and the thickened labor market causes the victimization rate facing each worker to fall.

In the conventional literature (e.g., Schelling 1967, Buchanan 1973, Backhaus 1979, Gambetta and Reuter 1995, and, more recently, Garoupa 2000), a criminal organization is often thought of as a monopolistic firm, and the theory of monopoly is predominantly used to analyze organized crimes. Because criminal activities are seen as "social bads" and because a monopolistic market structure is associated with a smaller "output of crime" than a perfectly competitive one, organized crimes are viewed as socially more preferred. Although our numerical results suggest that higher monopoly power by the mafia lowers the overall crime rate, the equilibrium level of individual criminal activities increases.

Result 4. (Effects of Increasing the Mafia's Operating Activeness) *Under Assumptions 1-3, an increase in the number of active subdivisions in the criminal organization reduces the employment rate and the masses of individual criminals in both states, while increasing the victimization rate, the masses of organized criminals in both states, the overall crime rate and the ratio of organized to individual criminals. Moreover, it raises the probability of dismantling a subdivision, the equilibrium commission to soldiers and the mafia's surplus.*

While an increase in the mafia's monopoly power and operating activeness (measured by m) both yield a higher surplus incurred by the mafia, the former limits the output of organized crimes but the latter expands it. Thus, the latter results in opposite comparative-static outcomes concerning the criminal activities, the labor-market activities, crime composition, and the victimization rate. Because the probability of dismantling a subdivision depends exclusively on the mass of organized criminals in the acquisition state, its response to m must also be the opposite of its response to γ. Furthermore, as shown in Proposition 6, an increase in the mafia's operating activeness raises the potential profit and reduces the effective risk, thereby expanding the bargaining set and leading to an ambiguous effect on the soldiers' commissions. Our numerical results suggest that the former is much stronger than the latter under the benchmark parametrization. Thus, the equilibrium commission to soldiers rises.

It is evident from Results 1-4 that, in response to any labor-market, crime-policy and criminal organization changes, the unemployment and the overall crime rates always change in the same direction. This positive relationship between the unemployment and the crime rates corroborates the empirical findings in Raphael and Winter-Ebmer (2001) and Gould, Mustard and Weinberg (2002) as well as the theoretical results in Burdett, Lagos and Wright (2003, 2004), Huang, Laing and Wang (2004) and Engelhardt, Rocheteau and Rupert (2008).

In addition, our calibration analysis provides empirically testable implications for the equilibrium relationship between the overall crime rate and the composition of crimes. In particular, in response to changes in labor-market conditions, the overall crime rate and the ratio of organized to individual criminals exhibit a negative relationship. That is, while the economy-wide criminal activity declines, the proportion of more severe (organized) crimes rises due to the presence of a positive interdiction effect on organized crimes. This result implies that those labor-market policies aimed at improving labor-market opportunities (such as those discussed in Gould, Mustard and Weinberg 2002, Hoon and Phelps 2003, and Engelhardt, Rocheteau and Rupert 2008) may reduce the overall crime rate, but need not benefit the society if the detrimental effect from rising organized crime is sufficiently large. On the contrary, in response to changes in crime deterrence policies and the structure of the criminal organization, the overall crime rate and the ratio of organized to individual criminals exhibit a positive relationship. That is, when the economy-wide criminal activity is lower, the proportion of more severe crimes falls more than proportionately. This provides a rationale for a stronger crime-reduction effect of "sticks" than "carrots" in the sense of Corman and Mocan (2005).

4.2.2 On the Structure of the Criminal Organization and the Crime Rate

In our model there are two indicators that may capture the monopoly power of the mafia: one is the mafia's bargaining power γ (as used in the previous section) and another is the scale of the criminal organization, namely the number of subdivisions n. Result 3 points out a common notion in the literature whereby a higher monopoly power is associated with a lower crime rate. To have a more complete picture, we now turn to investigating the relationship between the scale of the criminal organization measured by n and the overall crime rate measured by $(\bar{N} - N)/\bar{N}$. When we change the scale of the criminal organization, we maintain the same extent of the mafia's operating activeness, i.e., $m/n = 3/4$. Moreover, we note that the mafia's cost structure considered in the benchmark model consists of a variable cost depending on the number of active soldiers and a fixed cost that is independent of the number of active soldiers. When we consider changing the scale of the criminal organization, we must allow this "fixed cost" to rise with its scale; otherwise, it is always profitable to have a larger criminal organization. This scale-dependent cost, in reality, captures the organizational cost incurred by managing criminal hierarchies (as argued by Gottschalk 2008). Specifically, we impose:

Assumption 4. $F = F(n) = F_0 \cdot n^{\varsigma}$.

To perform a numerical analysis, we further set $F_0 = 10 \cdot 20^{-\varsigma}$, which will restore our original parametrization $F = 10$ when $n = 20$. Based on our numerical outcomes, we highlight two particularly interesting cases: $\varsigma = 0.2$ and $\varsigma = 4$. We arrive at the following:

Result 5. *(The Effects of an Expansion in the Number of Subdivisions) Under Assumptions 1-4, the steady-state equilibrium possesses the following properties:*

(i) *In the case where $\varsigma = 0.2$, a larger scale of the criminal organization increases the masses of organized criminals in both states, the overall crime rate, the ratio of organized to individual criminals, the victimization rate, the equilibrium commission to soldiers, and the mafia's surplus, but decreases the employment rate and the masses of individual criminals in both states. The scale of the criminal organization raises (reduces) the probability of dismantling a subdivision and the mass of searching soldiers in each active subdivision if the scale of the organization is relatively small (large).*

(ii) *In the case where $\varsigma = 4$, a larger scale of the criminal organization has a negative effect on the equilibrium commission to soldiers, the probability of dismantling a subdivision, and the mass of searching soldiers in each active subdivision. When the scale of the criminal organization is relatively small (large), an increase in the scale of the organization raises (reduces) the masses of organized criminals in both states, the overall crime rate, the ratio of organized to individual criminals, the victimization rate, and the mafia's surplus, but lowers (increases) the employment rate and the masses of individual criminals in both states.*

By enlarging the scale of the criminal organization while maintaining the same extent of the mafia's operating activeness (at the same ratio $m/n = 3/4$), the number of subdivisions in the criminal organization must rise. Thus, when the effects of the rising fixed cost are sufficiently small (e.g., $\varsigma = 0.2$), the comparative statics must be largely similar to an increase in the mafia's operating activeness (i.e., a higher m) under which the mafia's output in terms of crime *expands* and individual crimes are crowded out, as shown in Figure 3. For a given victimization rate, the enlarged scale of the criminal organization increases both the mafia's surplus and the commission offered to soldiers. The thinner labor market causes the victimization rate facing each worker to rise, the employment rate to fall and the overall crime rate to increase. When the scale of the criminal organization is relatively small ($n \leq 16$), the mass of searching crews in each active subdivision (R_k^O) increases and the effective arrest rate is higher, a finding which is consistent with the result associated with a more active criminal organization. However, as the scale of the criminal organization continues to rise ($n > 16$), the associated fixed cost becomes larger and larger, thus forcing the mafia to reduce each subdivision's exposure and the effective arrest rate to remain profitable. That is, the net effect of the scale of the criminal organization on the effective arrest rate is nonmonotone, and crucially depends on the level of the criminal organization's scale.

We next turn to considering the case when the effects from the rising fixed costs are sufficiently large (e.g., $\varsigma = 4$ and $n \geq 20$). In this case, a continual increase in the scale of the criminal organization turns out to suppress the mafia's output in terms of crime, which subsequently encourages occupational switches to individual crimes and formal jobs. That is, the opposite effects occur with regard to the employment and overall crime rates as well as the composition of crimes. Of particular note is that, as long as the scale-dependent organizational cost function is sufficiently convex ($\varsigma = 4$), the rising fixed costs significantly decrease the potential profit, which subsequently induces the mafia to reduce not only the exposure of each active subdivision (and hence the effective arrest rate), but also the commission offered to soldiers.

It is interesting to note that, when the mafia's monopoly power is measured by the scale of the criminal organization rather than by the bargaining power, an increase in the monopoly power can be associated with a larger output of crime, in contrast to the conventional literature (cf. Schelling 1967, Buchanan 1973, Backhaus 1979, Gambetta and Reuter 1995 and Garoupa 2000). In addition, based on our calibration analysis, it may be concluded that the "optimal size" of the criminal organization from the mafia's viewpoint is to set the number of subdivisions at $n = 20$ at which the surplus is the highest ($s = 9.5308$) and the "market size" of the organized crime is the largest ($\Psi/(1 - \Psi) = 1$). Of course, from the society's point of view, this yields the worst scenario as the employment rate is the lowest (56%) and the overall crime and the victimization rates are the highest (30% and 5.75%, respectively).

5 Concluding Remarks

We have developed a general-equilibrium search-theoretic framework to examine the interactions between the formal labor market and the individual as well as the organized criminal activities. We have shown that changes in labor market conditions, crime deterrence policies and the hierarchical structure of the criminal organization may lead to very different occupational choice outcomes. These outcomes together with the endogenous determination of workers' victimization rates as well as criminals' success and arrest rates have led to very rich comparative-static results. We would like to highlight some interesting model predictions that help address the following questions regarding empirically testable hypotheses or policy implications.

- Are the relationships between the overall crime rate and the ratio of organized to individual criminals always positive? We have shown that while such a relationship is positive in response to changes in crime deterrence policies and the structure of the criminal organization, it is negative in response to changes in labor-market conditions.

- Is the level of crimes lower under a monopolized criminal organization? We have shown that the opposite applies when the mafia's monopoly power is measured by the scale of the criminal organization in which an increase in the monopoly power is associated with a larger output of crime.

- Can labor-market improvement programs serve as anti-crime policies to benefit the society? We have shown the possibility of a detrimental effect from rising organized crimes: while the economy-wide criminal activity falls, the proportion of more severe organized crimes rises due to the presence of a positive interdiction effect on organized crime.

- Would conventional crime deterrence policies be effective when the composition of crimes responds endogenously? We have shown that. due to this crime composition effect, the population of a particular type of criminal may rise in response to a tightened crime deterrence policy and that, due to the risk-sharing effect, the nonpecuniary punishment policy is not as effective as the arrest rate policy in terms of reducing the overall crime rate or discouraging the more severe organized crimes.

A natural extension to our occupational choice framework is to allow some criminals to participate in the formal labor market on a part-time basis. It is expected that the criminals' participation in the formal sector may dampen the effects of labor market conditions and crime deterrence policies. The second extension is to allow the mafia to endogenously determine the size of the criminal organization and/or the extent of the operating activeness. As one may expect, such endogenous adjustments in the hierarchical structure of the criminal organization may dampen the effectiveness of the crime deterrence policies. The third is to consider a "peer learning effect" in that the flow rate at which an organized criminal encounters a victim is positively related to the total mass of organized criminals in the acquisition state. This may yield strategic complementarity between the individual agent's occupational choice decisions, possibly resulting in the coexistence of high organized crime and low organized crime equilibria. Finally, our framework can be used to perform a normative analysis of the optimal law enforcement. In particular, how to design a deterrence policy against organized crimes may be very different from a more conventional policy against individual crimes. Of course, to successfully perform any of these extensions, it is necessary to further simplify the benchmark model.

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Appendix

(A major portion of the Appendix is not intended for publication.)

Proof of Proposition 1. From (9)-(14), the corresponding values are:

$$J_E = \frac{(r+\mu)\lambda w}{r(r+\lambda+\mu+\alpha)}, J_U = \frac{\mu(\lambda w - T)}{r(r+\lambda+\mu+\alpha)}, J_{R^I} = \frac{\beta^I(\phi^I \lambda w - \pi z)}{r(r+\lambda+\beta^I)},$$

$$J_{Q^I} = \frac{(r+\beta^I)(\phi^I \lambda w - \pi z)}{r(r+\lambda+\beta^I)}, J_{R^O} = \frac{\beta^O[b\lambda w - P(1+\sigma)z]}{r(r+\lambda+\beta^O)}, J_{Q^O} = \frac{(r+\beta^O)[b\lambda w - P(1+\sigma)z]}{r(r+\lambda+\beta^O)}.$$

The commission b must satisfy participation constraints facing the mafia and potential organized criminals. Using the above relationships, we can rewrite the participation constraint facing the mafia and potential criminals, $\Pi_M > \underline{\Pi}$ and $J_{R^I} > J_{R^O}$, as:

$$b < \frac{m}{n}\left[(1-P)\beta^O w - c - \frac{F}{R^O}\right] \equiv b_{\max}.$$

$$b > \phi^I \cdot \frac{\beta^I(r+\lambda+\beta^O)}{\beta^O(r+\lambda+\beta^I)} + [\frac{P(1+\sigma)}{\pi} - \frac{\beta^I(r+\lambda+\beta^O)}{\beta^O(r+\lambda+\beta^I)}]\left(\frac{\pi z}{\lambda w}\right) \equiv b_{\min}.$$

which determine the upper and lower bounds of the bargaining set. Solving (18) leads to the following first-order condition:

$$\frac{\partial \Sigma}{\partial b} = \left(\frac{\Pi_M - \Pi_U}{J_{R^O} - J_{R^I}}\right)^\gamma \left[(1-\gamma)\cdot\frac{\partial J_{R^O}}{\partial b} + \gamma\left(\frac{J_{R^O} - J_{R^I}}{\Pi_M - \Pi_U}\right)\cdot\frac{\partial \Pi_M}{\partial b}\right] = 0,$$

which together with the upper and lower bounds of the bargaining set yields (19). ■

Proof of Proposition 2. Differentiating (19) with respect to z and π leads to:

$$\frac{\partial b^*}{\partial z} = \frac{\gamma}{\lambda w}\left[P(1+\sigma) - \chi\pi\right] > 0,$$

$$\frac{\partial b^*}{\partial \pi} = \frac{\gamma z}{\lambda w}\left[(1+\sigma)\frac{\partial P}{\partial \pi} - \chi\right] - (1-\gamma)\frac{m\beta^O w}{n}\frac{\partial P}{\partial \pi} \gtrless 0,$$

where $\frac{\partial P}{\partial \pi} = \frac{R^O(1-P)}{m(1-\pi)} > 0$. ■

Proof of Lemma 1. From (21), $d_1 > 0$ iff $b^*\lambda w - P(1+\sigma)z > \chi(\phi^I \lambda w - \pi z)$, or, equivalently,

$$b^* = \gamma b_{\min} + (1-\gamma)b_{\max} > \chi\phi^I + [\frac{P(1+\sigma)}{\pi} - \chi]\frac{\pi z}{\lambda w} \equiv b_{\min},$$

where $\chi \equiv \frac{\beta^I(r+\beta^O+\lambda)}{\beta^O(r+\beta^I+\lambda)} \in (0,1)$. Thus, as long as $b_{\max} > b_{\min}$, $d_1 > 0$ always holds true. ■

Proof of Proposition 3. Given (19) and (21), we can use (20) to derive:

$$J^* = \tilde{J}_{R^O}(d_1) = \tilde{J}_{R^I}(d_1) = \frac{-q^I}{q^O - q^I}\cdot\frac{\beta^O[b^*\lambda w - P(1+\sigma)z]}{r(r+\lambda+\beta^O)} + \frac{q^O}{q^O - q^I}\cdot\frac{\beta^I(\phi^I\lambda w - \pi z)}{r(r+\lambda+\beta^I)}.$$

By referring to Figures 1(a) and 1(b), we can see that $J^* > \tilde{J}_U$, the equilibrium is characterized by Case I; otherwise, Case II is true. Given $J_U = \frac{\mu(\lambda w - T)}{r(r+\lambda+\mu+\alpha)}$, the condition $J^* > \tilde{J}_U$ is equivalent to:

$$\frac{-q^I}{q^O - q^I} \cdot \frac{\beta^O[b^* \lambda w - P(1+\sigma)z]}{r(r+\lambda+\beta^O)} + \frac{q^O}{q^O - q^I} \cdot \frac{\beta^I(\phi^I \lambda w - \pi z)}{r(r+\lambda+\beta^I)} > J_U = \frac{\mu(\lambda w - T)}{r(r+\lambda+\mu+\alpha)}$$

or,

$$[1-(1-\gamma)a_q]b_{\min} + (1-\gamma)a_q b_{\max} > \frac{\mu(r+\lambda+\beta^O)}{\beta^O(r+\lambda+\mu+\alpha)}(1-\frac{T}{\lambda w}) + \frac{P(1+\sigma)z}{\lambda w} = \hat{b}. \blacksquare$$

Proof of Proposition 4. From (19), (21) and (22), we can easily show:

$$\frac{\partial d_1}{\partial \mu} = 0, \frac{\partial d_2}{\partial \mu} = \frac{-1}{q^I}\frac{\lambda w(r+\lambda+\alpha)}{r(r+\lambda+\mu+\alpha)^2} < 0. \blacksquare$$

Proof of Proposition 5. From (21) and (22), straightforward differentiation with respect to z implies:

$$\begin{aligned}
\frac{\partial d_1}{\partial z} &= \frac{-1}{q^O - q^I}\frac{\beta^O(1-\gamma)}{r(r+\lambda+\beta^O)}[P(1+\sigma) - \chi\pi] < 0,\\
\frac{\partial d_2}{\partial z} &= \frac{-1}{q^I}\frac{\beta^I \pi}{r(r+\lambda+\beta^I)} < 0,\\
\frac{\partial \Delta d_2}{\partial z} &= \frac{1}{q^O - q^I}\frac{\beta^O \chi\pi}{r(r+\lambda+\beta^O)}\left(\theta^z - \frac{q^O - q^I}{q^I}\right) \gtrless 0,
\end{aligned}$$

where $\theta^z \equiv \frac{(1-\gamma)[P(1+\sigma)-\chi\pi]}{\chi\pi} > 0$ and $P(1+\sigma) > \chi\pi$ because $P - \pi = (1-\pi)[1-(1-\pi)^{R^O/m-1}] > 0$ and $\chi < 1$. By defining $\varepsilon_{P\pi} \equiv \frac{\partial P}{\partial \pi}\frac{\pi}{P} > 0$, we can also derive:

$$\begin{aligned}
\frac{\partial d_1}{\partial \pi} &= \frac{-1}{q^O - q^I}\frac{\beta^O z(1-\gamma)}{r(r+\lambda+\beta^O)\pi}\left\{\left[\frac{m\beta^O P\lambda w^2}{nz}\right]\varepsilon_{P\pi} + [P(1+\sigma)\varepsilon_{P\pi} - \chi\pi]\right\},\\
\frac{\partial d_2}{\partial \pi} &= \frac{-1}{q^I}\frac{\beta^I z}{r(r+\lambda+\beta^I)} < 0,\\
\frac{\partial \Delta d_2}{\partial \pi} &= \frac{1}{q^O - q^I}\frac{\beta^O z\chi}{r(r+\lambda+\beta^O)}\left(\theta^\pi - \frac{q^O - q^I}{q^I}\right) \gtrless 0,
\end{aligned}$$

where $\theta^\pi \equiv \frac{(1-\gamma)[P(1+\sigma)-\chi\pi]}{\chi\pi} + \frac{P(1-\gamma)\cdot\varepsilon_{P\pi}}{\chi\pi}\left[\frac{m\beta^O\lambda w^2}{nz} + \frac{(1+\sigma)(\varepsilon_{P\pi}-1)}{\varepsilon_{P\pi}}\right] > \theta^z$. It is evident that $\frac{\partial d_1}{\partial \pi} < 0$ if $\varepsilon_{P\pi} > 1$. $\blacksquare$

Proof of Proposition 6. From (21) and (22), we obtain:

$$\begin{aligned}
\frac{\partial d_1}{\partial \gamma} &= \frac{1}{q^O - q^I}\frac{\beta^O \lambda w}{r(r+\lambda+\beta^O)}\frac{\partial b^*}{\partial \gamma} < 0,\\
\frac{\partial d_1}{\partial m} &= \frac{1}{q^O - q^I}\frac{\beta^O \lambda w}{r(r+\lambda+\beta^O)}\frac{\partial b^*}{\partial m} \gtrless 0,\\
\frac{\partial d_2}{\partial \gamma} &= \frac{\partial d_2}{\partial m} = 0,
\end{aligned}$$

where $\frac{\partial b^*}{\partial m} = (1-\gamma)\frac{b_{\max}}{m} + [\frac{\gamma(1+\sigma)z}{\lambda w} - (1-\gamma)\frac{m}{n}\beta^O w]\frac{\partial P}{\partial m} \gtrless 0$, $\frac{\partial P}{\partial m} = \frac{(1-P)R^O}{m^2}\ln(1-\pi) < 0$ and $\frac{\partial b^*}{\partial \gamma} = b_{\min} - b_{\max} < 0$. ■

Proof of Lemma 2. From (1) and (6)-(8) we can express the steady-state equilibrium values (N, E, U, Ψ, Q^I, R^I, Q^O) as a function of (R^O, α):

$$
\begin{aligned}
N(R^O,\alpha) &= \frac{(\lambda+\delta)(\lambda+\delta+\mu+\alpha)[mR^O\beta^O+(m-nR^O)\beta^I]}{m[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)\beta^I+(\lambda+\delta)\mu\alpha]},\\
E(R^O,\alpha) &= \frac{(\lambda+\delta)\mu[mR^O\beta^O+(m-nR^O)\beta^I]}{m[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)\beta^I+(\lambda+\delta)\mu\alpha]},\\
U(R^O,\alpha) &= \frac{(\lambda+\delta)(\lambda+\delta+\alpha)[mR^O\beta^O+(m-nR^O)\beta^I]}{m[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)\beta^I+(\lambda+\delta)\mu\alpha]},\\
\Psi(R^O,\alpha) &= \frac{[(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I+(\lambda+\delta)\mu\alpha][m\beta^O+n(\lambda+\delta)]R^O}{(\lambda+\delta)[(\lambda+\delta+\beta^I)m\mu\alpha+(\lambda+\delta)(\lambda+\delta+\mu+\alpha)(n\beta^I-m\beta^O)R^O]},\\
Q^I(R^O,\alpha) &= \frac{\beta^I\left\{(\lambda+\delta)m\mu\alpha-R^O[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)m\beta^O+(\lambda+\delta)n\mu\alpha]\right\}}{m(\lambda+\delta)[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)\beta^I+(\lambda+\delta)\mu\alpha]},\\
R^I(R^O,\alpha) &= \frac{(\lambda+\delta)m\mu\alpha-R^O[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)m\beta^O+(\lambda+\delta)n\mu\alpha]}{m[(\lambda+\delta+\alpha)(\lambda+\delta+\mu)\beta^I+(\lambda+\delta)\mu\alpha]},\\
Q^O(R^O,\alpha) &= \frac{\beta^O R^O}{\lambda+\delta}.
\end{aligned}
$$

Under Assumption 2, straightforward differentiation implies:

$$
\begin{aligned}
\frac{\partial N}{\partial\alpha} &= \frac{-(\lambda+\delta)(\lambda+\delta+\mu)(\lambda+\delta+\beta^I)\mu[m\beta^I+R^O(m\beta^O-n\beta^I)]}{m[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]^2}<0,\\
\frac{\partial E}{\partial\alpha} &= \frac{-\mu(\lambda+\delta)[(\lambda+\delta)\mu+(\lambda+\delta+\mu)\beta^I][m\beta^I+R^O(m\beta^O-n\beta^I)]}{m\left[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I\right]^2}<0,\\
\frac{\partial U}{\partial\alpha} &= \frac{-(\lambda+\delta)^3\mu[m\beta^I+R^O(m\beta^O-n\beta^I)]}{m\left[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I\right]^2}<0,\\
\frac{\partial\Psi}{\partial\alpha} &= \frac{-(\lambda+\delta+\mu)(\lambda+\delta+\beta^I)\mu R^O[(\lambda+\delta)n+m\beta^O][m\beta^I+R^O(m\beta^O-n\beta^I)]}{[(\lambda+\delta+m\beta^I)\mu\alpha+(\lambda+\delta)(\lambda+\delta+\mu+\alpha)(n\beta^I-m\beta^O)R^O]^2}<0,\\
\frac{\partial Q^I}{\partial\alpha} &= \frac{(\lambda+\delta)(\lambda+\delta+\mu)\mu\beta^I[m\beta^I+R^O(m\beta^O-n\beta^I)]}{m[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]^2}>0,\\
\frac{\partial R^I}{\partial\alpha} &= \frac{(\lambda+\delta)^2(\lambda+\delta+\mu)\mu[m\beta^I+(m\beta^O-n\beta^I)R^O]}{m\left[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I\right]^2}>0,\\
\frac{\partial Q^O}{\partial\alpha} &= 0.
\end{aligned}
$$

$$
\begin{aligned}
\frac{\partial N}{\partial R^O} &= \frac{(\lambda+\delta)(\lambda+\delta+\mu+\alpha)(m\beta^O-n\beta^I)}{m[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]}>0 \\
\frac{\partial E}{\partial R^O} &= \frac{\mu(\lambda+\delta)(m\beta^O-n\beta^I)}{m\left[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I\right]}>0, \\
\frac{\partial U}{\partial R^O} &= \frac{(\lambda+\delta)(\lambda+\delta+\alpha)(m\beta^O-n\beta^I)}{m[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]}>0, \\
\frac{\partial \Psi}{\partial R^O} &= \frac{m\mu\alpha(\lambda+\delta+\beta^I)[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I][(\lambda+\delta)n+m\beta^O]}{(\lambda+\delta)[\mu\alpha(\lambda+\delta+m\beta^I)+(\lambda+\delta)(\lambda+\delta+\mu+\alpha)(n\beta^I-m\beta^O)R^O]^2}>0, \\
\frac{\partial Q^I}{\partial R^O} &= \frac{-\beta^I[(\lambda+\delta)n\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)m\beta^O]}{m(\lambda+\delta)[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]}<0, \\
\frac{\partial R^I}{\partial R^O} &= \frac{-[(\lambda+\delta)n\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)m\beta^O]}{m[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]}<0, \\
\frac{\partial Q^O}{\partial R^O} &= \frac{\beta^O}{(\lambda+\delta)}>0. \blacksquare
\end{aligned}
$$

Proof of Lemma 3. To begin, we note that

$$
\begin{aligned}
\frac{\partial(U+R^I)}{\partial R^O} &= \frac{-[(\lambda+\delta)(\lambda+\delta+\alpha)n\beta^I+(\lambda+\delta)n\mu\alpha+(\lambda+\delta+\alpha)m\mu\beta^O]}{m[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I]}<0, \\
\frac{\partial(U+R^I)}{\partial \alpha} &= \frac{(\lambda+\delta)^2\mu^2[m\beta^I+R^O(m\beta^O-n\beta^I)]}{m\left[(\lambda+\delta)\mu\alpha+(\lambda+\delta+\mu)(\lambda+\delta+\alpha)\beta^I\right]^2}>0.
\end{aligned}
$$

From (26) and (27), we can then obtain:

$$
\begin{aligned}
\Omega^1_{R^O} &\equiv \frac{mn\left[U+R^I-R^O\frac{\partial(U+R^I)}{\partial R^O}\right]}{(mU+mR^I+nR^O)^2}-\frac{\partial d_1}{\partial R^O}>0, \\
\Omega^1_{\alpha} &\equiv \frac{-mnR^O}{(mU+mR^I+nR^O)^2}\frac{\partial(U+R^I)}{\partial\alpha}-\frac{\partial d_1}{\partial\alpha}<0, \\
\Omega^2_{R^0} &\equiv \frac{m\left[\left(mU^*+nR^O\right)\frac{\partial R^I}{\partial R^O}-mR^I\cdot\frac{\partial U}{\partial R^O}-nR^I\right]}{(mU+mR^I+nR^O)^2}-\frac{\partial\Delta d_2}{\partial R^O}<0, \\
\Omega^2_{\alpha} &\equiv \frac{m\left[\left(mU+nR^O\right)\frac{\partial R^I}{\partial\alpha}-mR^I\cdot\frac{\partial U}{\partial\alpha}\right]}{(mU+mR^I+nR^O)^2}-\frac{\partial\Delta d_2}{\partial\alpha}\gtrless 0,
\end{aligned}
$$

where $\frac{\partial d_1}{\partial\alpha}=0$, $\frac{\partial d_1}{\partial R^O}=\frac{\beta^O\lambda w(1-\gamma)}{r(q^O-q^I)(r+\lambda+\beta^O)}\frac{\partial b_{\max}}{\partial R^O}<0$, $\frac{\partial\Delta d_2}{\partial\alpha}=\frac{\mu\lambda w}{rq^I(r+\lambda+\mu+\alpha)^2}>0$, $\frac{\partial\Delta d_2}{\partial R^O}=-(\frac{\partial d_1}{\partial R^O}+\frac{\nu\pi\mu}{E^2rq^I(r+\lambda+\mu+\alpha)}\frac{\partial E}{\partial R^O})>0$ if the indirect tax revenue effect is not too strong, and $\frac{\partial b_{\max}}{\partial R^O}=\frac{1}{n}[(1-P)\beta^O w\cdot\ln(1-\pi)+\frac{F}{(R^O)^2}]<0$ if the mafia's willingness to offer commission is decreasing in R^O. Under the normality condition that better labor market conditions reduce criminal activities, $\Omega^2_\alpha>0$ (which implies $\frac{d\alpha}{dR^O}\big|_{OC^{IW}}>0$) and $\frac{d\alpha}{dR^O}\big|_{OC^{IW}}<\frac{d\alpha}{dR^O}\big|_{OC^{IO}}$. $\blacksquare$

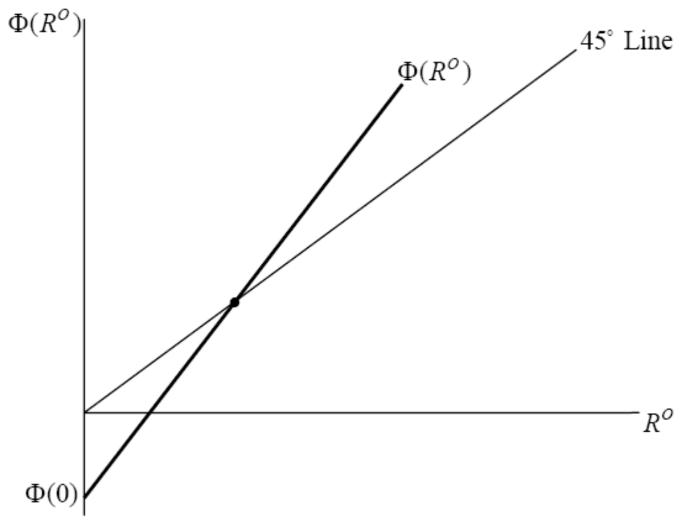
Proof of Proposition 7. We can use (26) and (27) to solve the steady-state equilibrium. We first use (26) and apply implicit function theorem to obtain: $\alpha=f(R^O)$. We then substitute the above relationship into (27) to yield:

$$\frac{mR^I(R^O, f(R^O))}{mU(R^O, f(R^O)) + mR^I(R^O, f(R^O)) + nR^O} = \Delta d_2(R^O, f(R^O))$$

or, equivalently,

$$R^O = \Phi(R^O) \equiv \frac{m}{n}\left[(\frac{1}{\Delta d_2(R^O, f(R^O))} - 1)R^I(R^O, f(R^O)) - U(R^O, f(R^O))\right]$$

This fixed point mapping $\Phi(R^O)$ is plotted below:



We first show that $\Phi(R^O)$ is increasing in R^O and steeper than the 45° line. Specifically,

$$\frac{d\Phi(R^O)}{dR^O} = m\left[1 + \frac{1}{n}\left(\left.\frac{d\alpha}{dR^O}\right|_{OC^{IO}} - \left.\frac{d\alpha}{dR^O}\right|_{OC^{IW}}\right)\cdot\nabla\right]$$

where $\nabla = \left[(mU + nR^O)\frac{\partial R^I}{\partial\alpha} - mR^I\frac{\partial U}{\partial\alpha} - \frac{(mU+mR^I+nR^O)^2}{mR^I}\frac{\partial\Delta d_2}{\partial\alpha}\right] > 0$. From Lemma 3, $\left.\frac{d\alpha}{dR^O}\right|_{OC^{IO}} - \left.\frac{d\alpha}{dR^O}\right|_{OC^{IW}} > 0$. Thus, given that $m > 1$, we have: $\frac{\partial\Phi(R^O)}{\partial R^O} > 1$.

We next show that $\Phi(0) < 0$. Suppose that $\underline{\alpha} \equiv \lim_{R^O\to 0} f(R^O) > 0$; that is, there is a minimum level of α to ensure a nondegenerate measure of criminals. Then, under Assumption 3,

$$\Phi(0) = \frac{m}{n}\left[(\frac{1}{\lim_{R^O\to 0}\Delta d_2(R^O,\underline{\alpha})} - 1)\frac{\mu\underline{\alpha}(\lambda+\delta)}{(\lambda+\delta+\underline{\alpha})(\lambda+\delta+\mu)\beta^I + \mu\underline{\alpha}(\lambda+\delta)} - \frac{(\lambda+\delta)(\lambda+\delta+\underline{\alpha})\beta^I}{(\lambda+\delta+\underline{\alpha})(\lambda+\delta+\mu)\beta^I + \mu\underline{\alpha}(\lambda+\delta)}\right] < 0.$$

This together with $\frac{d\Phi(R^O)}{dR^O} > 1$ implies the existence of a unique fixed point $R^O > 0$. ■

Benchmark values	
β^I	0.2972
β^O	0.693467
μ	0.824376
η	0.824376
γ	0.75
δ	0.1386
λ	0.01
w	8
π	0.1
z	0.126188
ν	350
σ	1
r	0.14
q^I	0.9
q^O	1.2
a	0.45
c	1.83208
ξ	2/3

Table 1. Benchmark Parameter Values

Variables		$E/\bar{N}$	α	b^*	P	s	$(\bar{N}-N)/\bar{N}$
Benchmark Model		0.56	0.0575	1.5307	0.1610	9.5308	0.3
μ	−5%	0.5420	0.0617	1.5344	0.1630	9.3919	0.3124
	−1%	0.5565	0.0583	1.5315	0.1614	9.5040	0.3024
	+1%	0.5634	0.0567	1.5300	0.1607	9.5571	0.2976
	+5%	0.5766	0.0538	1.5271	0.1591	9.6578	0.2886
π	−5%	0.5516	0.0601	1.5406	0.1593	10.2789	0.3087
	−1%	0.5583	0.0580	1.5327	0.1607	9.6737	0.3017
	+1%	0.5616	0.0570	1.5287	0.1614	9.3910	0.2983
	+5%	0.5681	0.0550	1.5206	0.1627	8.8619	0.2916
z	−5%	0.5559	0.0588	1.5210	0.1637	9.8377	0.3043
	−1%	0.5592	0.0577	1.5288	0.1616	9.5909	0.3009
	+1%	0.5608	0.0572	1.5326	0.1605	9.4713	0.2991
	+5%	0.5641	0.0563	1.5399	0.1585	9.2394	0.2957
γ	−5%	0.5577	0.0583	1.5556	0.1676	8.5889	0.3023
	−1%	0.5595	0.0577	1.5361	0.1625	9.3383	0.3005
	+1%	0.5605	0.0573	1.5251	0.1596	9.7246	0.2995
	+5%	0.5629	0.0564	1.4996	0.1528	10.5048	0.2971
m	−5%	0.5704	0.0538	1.4767	0.1468	7.7943	0.2895
	−1%	0.5621	0.0567	1.5204	0.1583	9.1832	0.2979
	+1%	0.5578	0.0583	1.5409	0.1637	9.8788	0.3022
	+5%	0.5488	0.0617	1.5796	0.1739	11.2756	0.3112

Table 2. Quantitative Comparative-Static Results

Variables		$\Psi/(1-\Psi)$	Q^I	R^I	Q^O	R^O+R^H
Benchmark Model		1	100	50	116.667	33.3334
μ	−5%	0.9478	106.936	53.4681	118.248	33.7852
	−1%	0.9895	101.330	50.6651	116.980	33.4229
	+1%	1.0105	98.6964	49.3482	116.355	33.2442
	+5%	1.0527	93.7358	46.8679	115.121	32.8916
π	−5%	1.0270	101.538	50.7688	121.663	34.7609
	−1%	1.0051	100.318	50.1591	117.635	33.6101
	+1%	0.9950	99.6764	49.8382	115.713	33.0608
	+5%	0.9766	98.3352	49.1676	112.038	32.0107
z	−5%	1.0075	101.062	50.5311	118.786	33.9388
	−1%	1.0014	100.214	50.1071	117.084	33.4527
	+1%	0.9986	99.7848	49.8924	116.252	33.2149
	+5%	0.9933	98.9160	49.4580	114.624	32.7498
γ	−5%	1.0758	97.0914	48.5457	121.861	34.8173
	−1%	1.0161	99.3684	49.6842	117.794	33.6555
	+1%	0.9834	100.660	50.3298	115.489	32.9968
	+5%	0.9112	103.624	51.8122	110.195	31.4843
m	−5%	0.8188	106.130	53.0648	100.204	30.1366
	−1%	0.9626	101.175	50.5877	113.368	32.7181
	+1%	1.0380	98.8461	49.4230	119.972	33.9382
	+5%	1.1970	94.4247	47.2124	133.279	36.2664

Table 2. Quantitative Comparative-Static Results (Conti.)

$\varsigma = 0.2$	$n=12$	$n=14$	$n=16$	$n=18$	$n=20$	$n=22$
$E/\bar{N}$	0.5807	0.5750	0.5697	0.5647	0.56	0.5556
α	0.0502	0.0522	0.0540	0.0558	0.0575	0.0591
b^*	1.4932	1.5106	1.5209	1.5271	1.5307	1.5327
P	0.1612	0.1634	0.1635	0.1626	0.1610	0.1591
s	3.4411	4.8232	6.3116	7.8867	9.5308	11.2283
$(\bar{N}-N)/\bar{N}$	0.2793	0.2850	0.2903	0.2953	0.3	0.3044
$\Psi/(1-\Psi)$	0.4762	0.5982	0.7252	0.8588	1	1.1498
Q^I	126.113	118.882	112.183	105.909	100	94.4128
R^I	63.0563	59.4410	56.0914	52.9546	50	47.2064
Q^O	70.0678	82.9655	94.9189	106.116	116.667	126.645
R^O+R^H	20.0194	23.7044	27.1197	30.319	33.3334	36.1842
R_K^O	1.6683	1.6932	1.6950	1.6844	1.6667	1.6447
$\varsigma = 4$	$n=12$	$n=14$	$n=16$	$n=18$	$n=20$	$n=22$
$E/\bar{N}$	0.5709	0.5664	0.5629	0.5606	0.56	0.5623
α	0.0536	0.0552	0.0564	0.0573	0.0575	0.0567
b^*	1.6534	1.6332	1.6078	1.5750	1.5307	1.4650
P	0.2063	0.1973	0.1872	0.1754	0.1610	0.1415
s	5.9417	7.3147	8.4964	9.3157	9.5308	8.7116
$(\bar{N}-N)/\bar{N}$	0.2891	0.2936	0.2971	0.2994	0.3	0.2977
$\Psi/(1-\Psi)$	0.6938	0.8102	0.9109	0.9814	1	0.9293
Q^I	113.766	108.108	103.652	100.742	100	102.874
R^I	56.8832	54.0541	51.8259	50.3711	50	51.4372
Q^O	92.0928	102.191	110.146	115.341	116.667	111.534
R^O+R^H	26.3122	29.1975	31.4704	32.9546	33.3334	31.8669
R_K^O	2.1927	2.0855	1.9669	1.8308	1.6667	1.4485

Table 3. The Effects of an Expansion in Mafia's Scale *n*

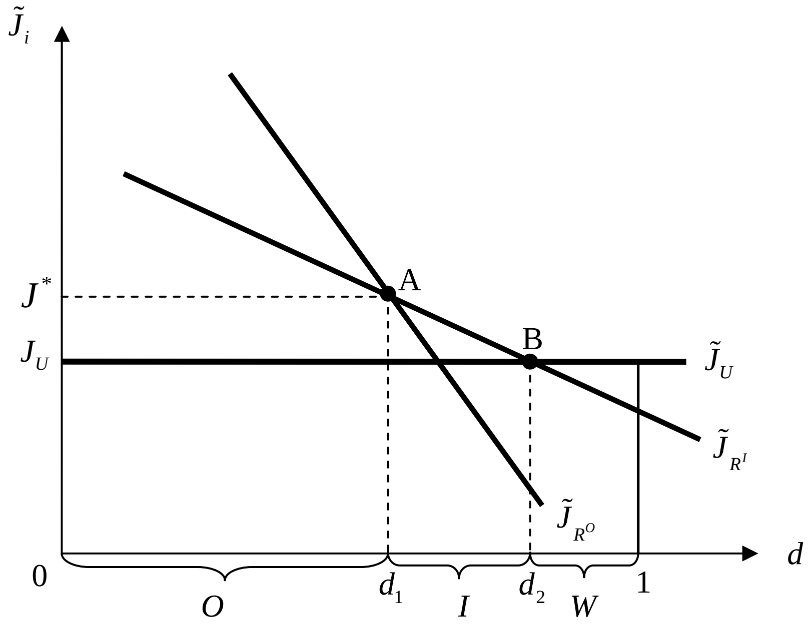


Figure 1a. Occuptional Choice: Case I

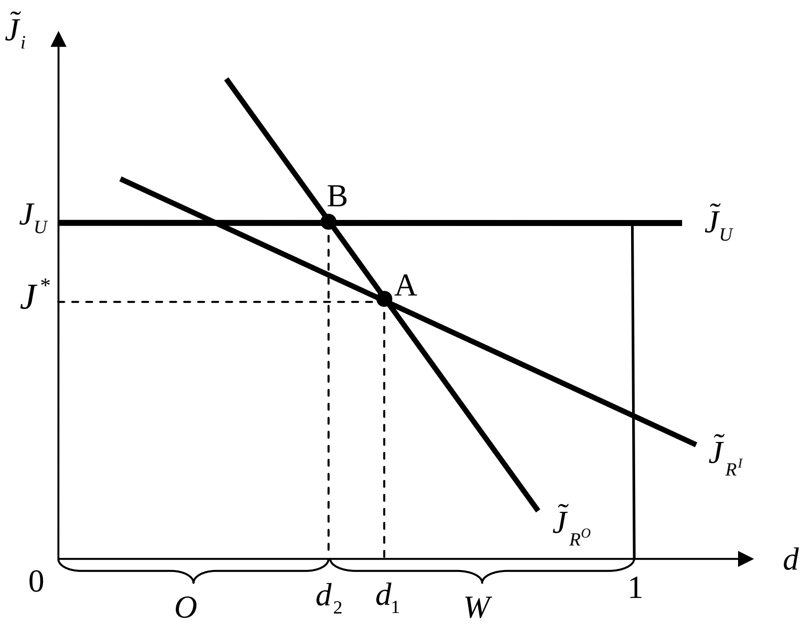


Figure 1b. Occuptional Choice: Case Ⅱ

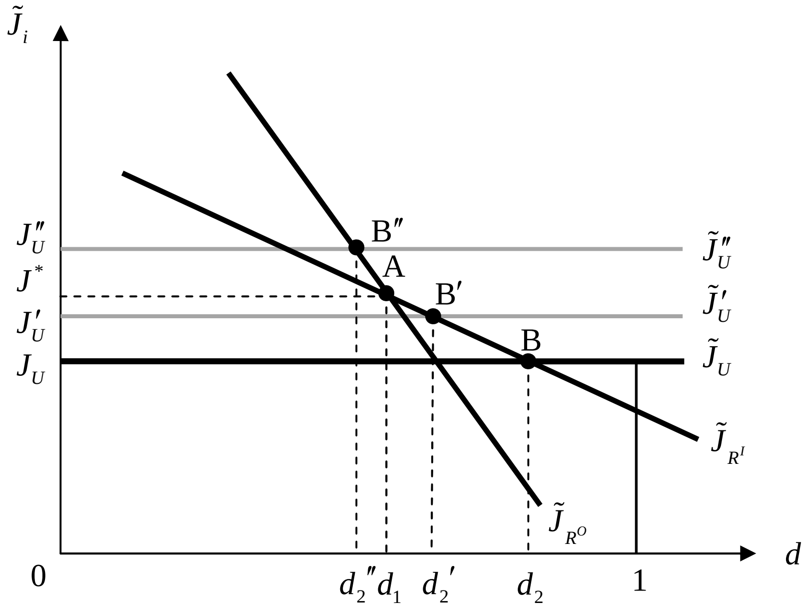


Figure 2a. An Increase in μ

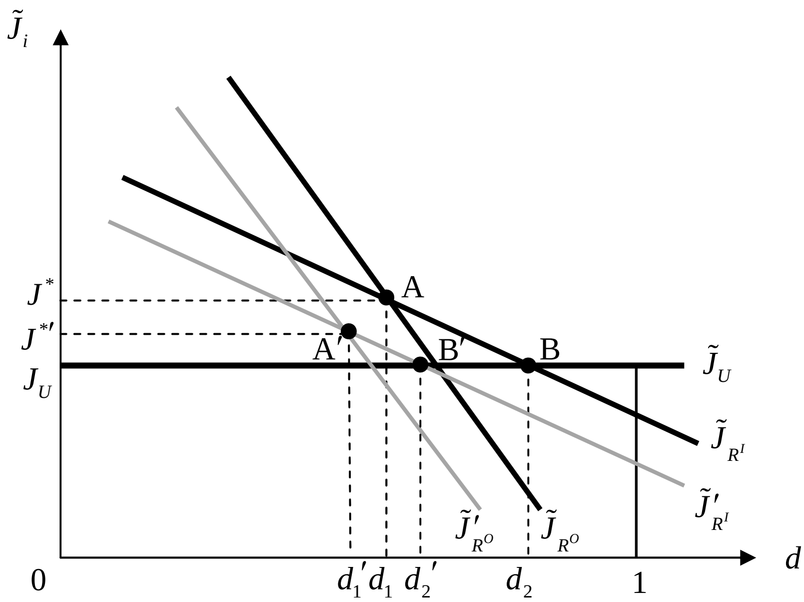


Figure 2b. An Increase in z or π

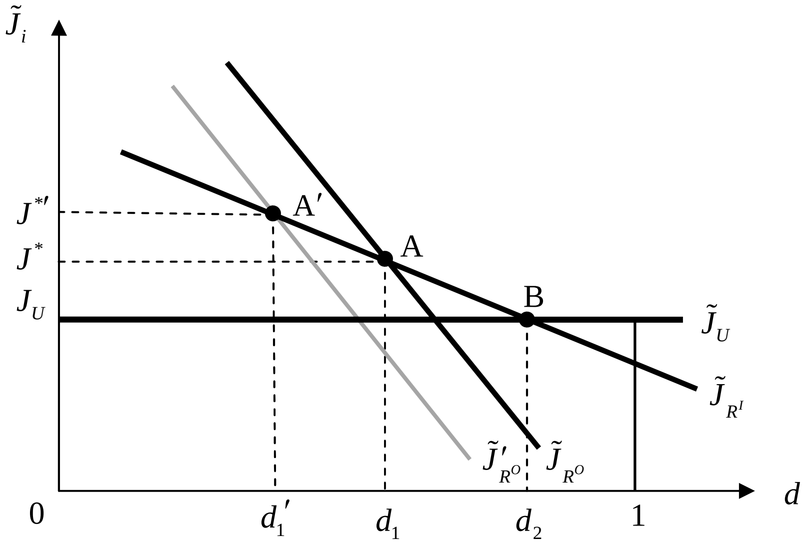


Figure 2c. An Increase in γ

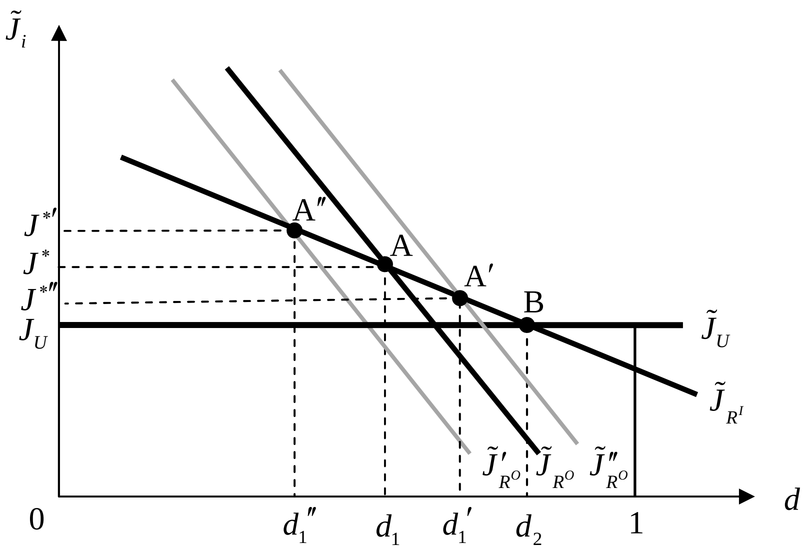


Figure 2d. An Increase in m

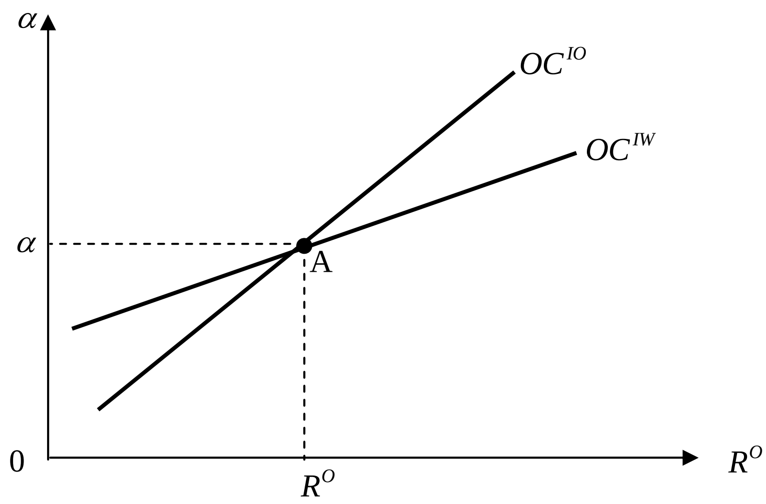


Figure 3. The Determination of Equilibrium (R^{O*}, α^*)

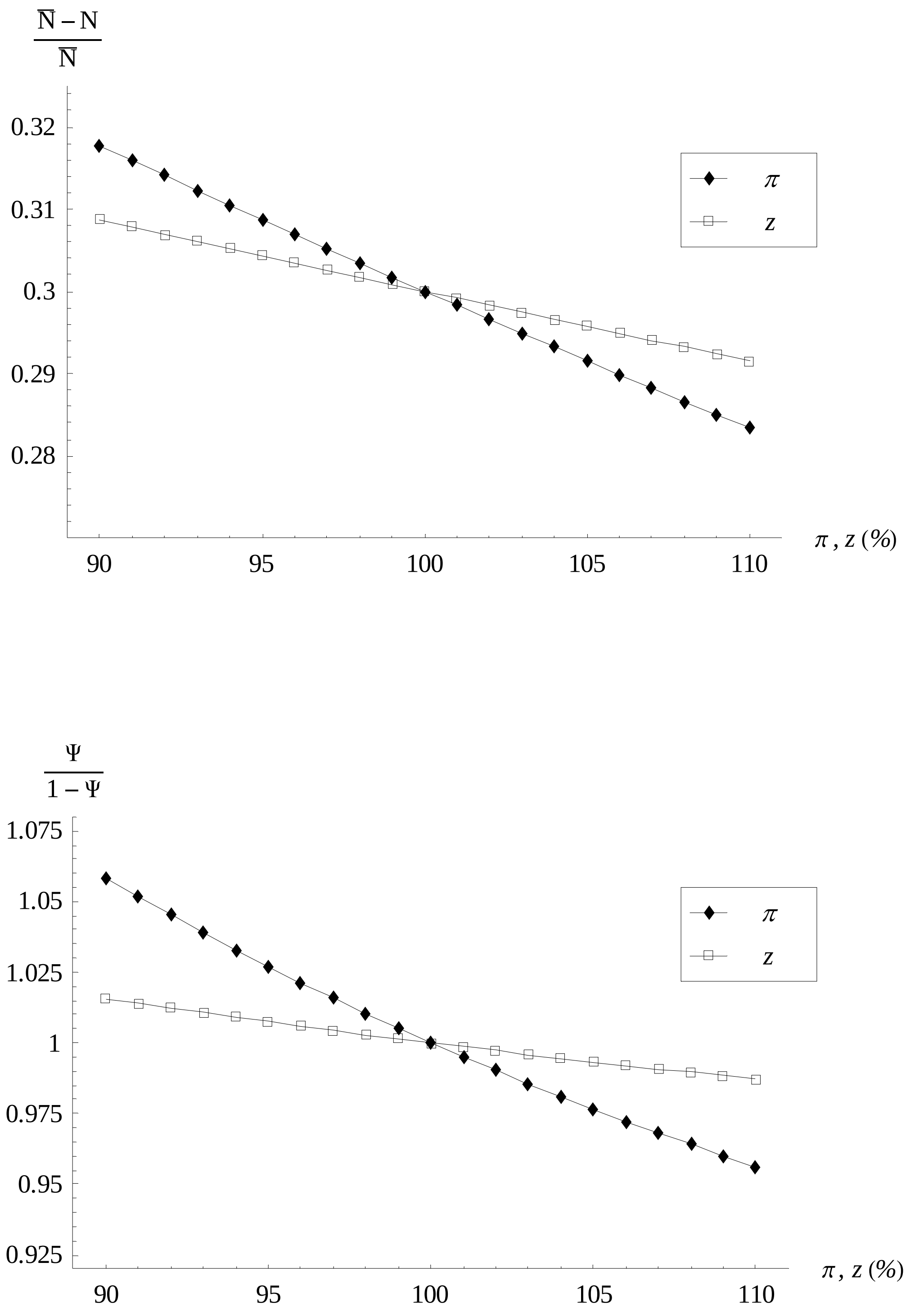


Figure 4. The Marginal Effects of Crime Deterrence Policies