CRIME, ETHICS AND OCCUPATIONAL CHOICE: ENDOGENOUS SORTING IN A CLOSED MODEL

by

John P. Conley and Ping Wang

Working Paper No. 04-W02

January 2004

DEPARTMENT OF ECONOMICS
VANDERBILT UNIVERSITY
NASHVILLE, TN 37235

www.vanderbilt.edu/econ

Crime, Ethics and Occupational Choice: Endogenous Sorting in a Closed Model

John P. Conley, Vanderbilt University

Ping Wang, Vanderbilt University and NBER

January 20, 2004

Abstract: We consider a simple model in which agents are endowed with heterogeneous abilities and differing degrees of honesty. Agents choose either to become criminals or invest in education and become workers instead. The model is closed in that all criminal proceeds are stolen from agents working in the formal sector and that expenditures on both deterrence and punishment of criminals are paid for through taxes levied on workers. Thus, although we assume that there no direct interactive effects among criminals, criminals crowd each other in two ways: positively in that enforcement and punishment resources become more widely diffused as more agents commit crimes, and negatively in that the presence of more criminals implies that there is less loot to be divided over a larger number of thieves. We establish the possibility of multiple equilibria and characterize the equilibrium properties. We then evaluate the effectiveness of deterrence policies under a balanced government budget.

JEL Classification: I2, J2, J62, K42.

Keywords: Criminal Behavior, Educational Choice, Punishment

Acknowledgment: We are grateful to comments and suggestions by Marcus Berliant, Derek Laing, Lance Lochner, Peter Rupert, Jay Wilson and Myrna Wooders. Needless to say, any remaining errors are solely the authors' responsibility.

Correspondence: John P. Conley, Department of Economics, Vanderbilt University, Nashville, TN 37235, U.S.A.; j.p.conley@vanderbilt.edu.

1 Introduction

In the United States, criminal activity has been geographically concentrated, associated with low education, high unemployment and poverty.[1] Crime rates rose in the U.S. during the 1980s but then fell during the 1990s.[2] In 1990, about 2% of the U.S. workforce was incarcerated and about 7% of the workforce was incarcerated, paroled or on probation. The median number of reported street robberies in Los Angeles equaled 4 per 1000 residents, but 10% of neighborhoods had crime rates four times greater than the median.[3] While many studies have investigated the factors that might influence an individual to choose crime as an occupation, we are only beginning to consider the forces that might produce such differing equilibrium crime rates across time and place. The main purpose of this paper is to contribute to our understanding of this issue.

The earliest literature on the economics of crime considers what might be termed the "external incentives" for agents to choose illegal activity over work in the legitimate sector (cf. Becker, 1968, Ehrlich, 1973, and Davis, 1988). The effects of pecuniary and nonpecuniary punishments imposed on criminals on their decision making and the effectiveness of these public policies are the central concerns.

More recently, economists have begun to shift their attention to "internal motivations" for criminal behavior. [4] For example, Sah (1991) points out that the more criminals there are, the more wide-spread must be enforcement resources. He formal-

[1] For empirical evidence relating education, unemployment and income to crimeactivity, see Grogger (1998), Gould, Mustard and Weinberg (2002) and Witte and Tauchen (1994), respectively.

[2] Grogger (1998) attributes the rise in the crime rate in the 1980s to the drop in the real wage rate for the youth, whereas İmrohoroğlu, Merlo and Rupert (2000) and Merlo (2001) regard the subsequent decline as a consequence of higher police enforcement.

[3] The geographical concentration of criminal activity has been documented by Freeman, Grogger and Sontselie (1996) and Glaeser, Sacerdote and Scheinkman (1996), among many others.

[4] The terminology of external incentives and internal motivations are taken from Rasmussen (1996). Internal motivations arise either from things that are internal to the agent (preferences or propensities, for example) or from interactions between agents. This is distinguished for the external actions of governments to affect criminal behavior.

izes this positive (to criminals) spillover and terms it the "interdiction effect." Glaeser, Sacerdote and Scheinkman (1996) model peer spillovers of criminal behavior, exploring how the presence of criminals can influence others to choose a life a crime as well. Lochner (1999) constructs a simple two-period life-cycle model to examine how the labor-market conditions affect crime and educational choices but without allowing the feedback effect that criminal activity can influence the net value of formal employment or criminal proceeds. İmrohoroğlu, Merlo, and Rupert (2000*a*) develop a competitive equilibrium model of crime with elastic labor supply, İmrohoroğlu, Merlo and Rupert (2000*b*) construct a political-economy model to study the effects of redistribution and policing on crime activity, both assuming exogenously given worker skills. Finally, Burdett, Lagos, and Wright (2001) and Huang, Laing, and Wang (2003) use a search-theoretic framework to model criminal decisions for one-dimensional heterogeneous agents and homogeneous agents, respectively.

One important factor that this literature seems to neglect is that agents may innately have different fundamental levels of honestly. Agents with weak ethics are naturally more likely to commit crime in all circumstances, although this will also interact with the abilities and other opportunities facing the agents. One could interpret the peer effects discussed in Glaeser *et al.* (1996) as being related to this. Specifically, one might think of bad peers as weakening the ethics of the agents they interact with and causing them to follow their example. It would be particularly interesting to investigate this story of interactive ethics formation in a multi-period model (the road to perdition?). Our approach here, however, is somewhat more modest. We consider only a static model in which agents arrive with a given level of honesty and explore how their choices that are informed by this internal moral compass.[5]

The existing literature also seems to be incomplete in its consideration of the general

[5]It should be pointed out that the Glaeser *et al.* (1996) paper could just as easily be interpreted as suggesting that having bad peers lowers the social penalty for bad behavior and so might have nothing to do withethics at all.

equilibrium effects of crime rates. A high crime rate creates both positive *and* negative incentives for additional agents to choose criminal behavior. On the positive side are the "interdiction effects" identified by Sah (1991): the more criminals there are, the less likely any individual one of them will be caught given a fixed level of enforcement expenditure. This might even lead to a social collapse in which chances of getting caught are so low that everyone finds it optimal to choose crime as an occupation. On the other hand, the loot taken by thieves must be produced by the rest of the economy. Thus, a higher fraction of criminals implies that there are fewer workers and so less total wealth to be stolen, which in turn must also be distributed over a larger number of criminals. This negative spillover, which tends to push the economy back to stable low-crime equilibrium, has not been formally explored in the literature. Closing the model in this way, however, also exposes an additional, under-explored, effect that generates instability: more agents choosing crime implies that there are fewer workers to pay the taxes needed to fund enforcement and punishment efforts. Thus, for a fixed level of expenditure, each time an agent chooses to become a criminal, taxes must increase on the remaining workers. This makes in turn makes being a worker less attractive than being a criminal, all else equal.

In this paper, we develop a general equilibrium framework to study endogenous sorting between working in the formal labor market and committing a crime.[6] Agents are endowed with heterogeneous abilities and different degrees of honesty. We allow agents to choose their own educational levels in response to market forces and do not rely on any direct peer externalities to drive our results. The local government authorities counter criminal activity with two complementary deterrence policies: policing and punishment. Thus, our paper contributes to the existing literature by (i) allowing for two-dimensional heterogeneity inability and in honesty, (ii) accounting for both ed-

[6]Block and Heineke(1975) emphasizes the aspect of time allocation between working and committing a crime, whereas we highlight occupational choice by endogenous sorting between the formal labor market and the criminal activity.

ucational and occupational choice in a general equilibrium model of crime with police enforcement and punishment. This framework enables us to examine both the external and internal margins of criminal behavior decision.

The main findings of the paper are summarized as follows. First, higher ability agents choose more education and get more income as a result regardless of their ethical level. Second, the indifference boundary in the ability-honesty space between work and crime is downward sloping. Thus, the set of criminals in the two dimensional agent-characteristic space is comprehensive. Third, while an all-crime equilibrium can never exist, there is always a no-crime equilibrium with low proceeds or under severe punishments. This no-crime equilibrium may coexist with an interior equilibrium associated with a positive crime rate. Fourth, lower proceeds or greater punishments discourage criminal behavior, whereas higher minimum wage only reduce the incentive of the less able to commit a crime.

2 The Basic Model

We consider a model with a continuum of individuals, each of whom possesses two basic characteristics: *intellectual ability* (a) and *ethical honesty* (h). We assume that these traits are uncorrelated and follow a joint uniform distribution: $G(a, h)$ over the compact support $[0, 1] \times [0, 1]$. We denote the set of agents in the economy by $\mathcal{I}$ and will identify individual agents by the their characteristics, thus, $(a, h) \in \mathcal{I}$.

Agents choose either to join the labor force or become criminals. If they choose to work, the wage they receive depends both on their basic intellectual ability, and the amount of education ($e \in [0, 1]$) they choose to obtain. The set of these choices will be denoted $e(a, h)$. Education is equally costly for all agents and this cost is given by: $C(e)$. We assume that $C(e) \geq 0$, $C'(e) > 0$, $C''(e) > 0$, and $\lim_{e \to 1} C'(e) = \infty$.

If an agent of type (a, h) chooses to work, he receives a gross compensation $W = W_0 + W_1 ae$, where W_0 is the minimum wage and $W_1 > 0$. Note that the variable compensation depends on the product of ability and education, but is unaffected by the honesty of the agent.

The compensation for an agent who turns to a life of crime is more complicated. We assume that it depends on the following:

- The fraction of agents who commit crimes: $\kappa \in [0, 1]$.
- The total wealth of the society: Y
- The part of that social wealth that the criminal class as whole steal, referred to it as the *loot*: L
- The probability of getting caught Π
- The aggregate jail expenditure: J
- The agent's level of honesty (the more honest the less an agent enjoys his ill-gotten proceeds): h

We develop this more formally as follows. Suppose we are at a sorting equilibrium in which a set of agents, $\mathcal{I}^c \subset \mathcal{I}$, have decided to become criminals and we denote the educational choice of any given worker agent $(a, h) \in \mathcal{I}^w \equiv \mathcal{I} \setminus \mathcal{I}^c$ by $e(a, h)$. Then the total national wealth is:

$$Y = \int_{(a,h)\in\mathcal{I}^w} [W_0 + W_1 a e(a, h) - C(e(a, h))] \, dG(a, h). \tag{1}$$

The more criminals in the society the higher the fraction of net social wealth is stolen from honest workers. Let $S(\kappa)$ give this fraction. Assume $S'(\kappa) > 0$, $S''(\kappa) \le 0$, $\lim_{\kappa\to 0} S(\kappa) = 0$ and $\lim_{\kappa\to 1} S(\kappa) < 1$.

To deter crime, working agents pay a flat proportional wage tax rate of τ and the resulting revenue is divided between expenditure on *police* (P) and *jails* (J). Note that feasibility requires that

$$\tau Y = P + J. \tag{2}$$

The effectiveness of police in catching criminals depends both on the level of expenditure, and the number of criminals. This is captured by:

$$\Pi(\kappa, P),$$

which gives the probability for a criminal to be caught as a function of two factors, κ and P. We assume: $\partial\Pi/\partial\kappa < 0$ (the *interdiction* effect), $\partial\Pi/\partial P > 0$, $\partial^2\Pi/\partial(\kappa)^2 > 0$, $\partial^2\Pi/\partial(P)^2 < 0$ (*diminishing returns* to enforcement), $\lim_{\kappa\to 0}\Pi(\kappa, P) = 1$ and $\lim_{\kappa\to 1}\Pi(\kappa, P) > 0$.

The spending on jails allows society to imposes a cost on criminals if they are caught. The more criminals who are caught by the police, the more thinly these punishment expenditures must be spread. Thus, the cost of punishment to a given criminal is given by the following function:

$$\lambda\left(\frac{J}{\Pi(\kappa, P)}\right), \tag{3}$$

where $\lambda' > 0$.

3 Occupational Choice

In addition to policy enforcement and conviction, two other factors effect the reward to criminal behavior. First, all else equal, the more criminals, the more widely the loot has to be divided. To keep matters simple, we will assume that the loot is divided equally across criminals. Second, the more honest an agent, the more he discounts gains from criminal activity. Putting this together we get the following equations for net compensation to an agent of type (a, h) from choosing to work and receiving a wage (w) or being a criminal and sharing the loot (ℓ):

$$w(a, h; \kappa; \tau, P, J) = (1 - S(\kappa))(1 - \tau)\max_e [W_0 + W_1 ae - C(e)] \tag{4}$$

$$\ell(a, h; \kappa; \tau, P, J) = \frac{1-h}{\kappa} S(\kappa)(1-\tau)Y - \Pi(\kappa, P)\lambda\left(\frac{J}{\Pi(\kappa, P)}\right). \tag{5}$$

An individual's occupational choice therefore lies on the comparison between these net compensations. One would choose to work in the formal sector if $w(a,h) > \ell(a,h)$ and to commit a crime if $w(a,h) < \ell(a,h)$.

Denoting the measure of a set by μ, a *feasible state* of the economy is $(\tau, P, J, \mathcal{I}^c, e)$ where $\tau Y = P + J$, $\kappa = \mu(\mathcal{I}^c)$ and Y is consistent with this κ. Thus, the set of agents who are indifferent between work and crime is defined by he following equation:

$$w(a, h; \kappa; \tau, P, J) = \ell(a, h; \kappa; \tau, P, J). \tag{6}$$

Call this locus the *Best Response Occupational Choice Boundary* ($BROCB$). More specifically, given a particular level of the crime rate κ and a set of policy parameters (τ, P, J) the $BROCB$ gives the cutoff level of honesty h as a function of a between crime and work being optimal choices for agents. Of course, it may be that for a given a that all agents should either commit crimes or work in the formal sector (meaning that equation (6) can never be satisfied for this a. We will therefore need to know the boundaries on the upper and lower side where occupational choice becomes trivial in this way.[7] Formally, let $a^{\max}$ be such that for all $a \geq a^{\max}$ and for all $h \in [0,1]$, $w(a,h;\kappa;\tau,P,J) \geq \ell(a,h;\kappa;\tau,P,J)$ if this exists and 1 otherwise. Similarly, let $a^{\min}$ be such that for all $a \leq a^{\min}$ and for all $h \in [0,1]$, $w(a,h;\kappa;\tau,P,J) \leq \ell(a,h;\kappa;\tau,P,J)$ if this exists and 0 otherwise Now, we can define the BROCB as follows:

$$BROCB(a;\kappa;\tau,P,J) = \begin{cases} 0 & a^{\max} < a \leq 1 \\ h \quad \text{s.t.} \quad (6) \text{ is met} & a^{\min} \leq a \leq a^{\max} \\ 1 & 0 \leq a < a^{\min} \end{cases} \tag{7}$$

The benchmark case is plotted in Figure 1A where $a^{\max}$ and $a^{\min}$ do not exist. An alternative case with both $a^{\max}$ and $a^{\min}$ existent is depicted in Figure 1B. For brevity, we do not display two other possible cases with either $a^{\max}$ or $a^{\min}$ existent.

Note that this is a best response boundary in the sense that all agents take the parameters (κ, τ, P, J) as given. Thus, it may be that the crime rate κ is not consistent

[7] We will show below that the $BROCB$ is downward sloping, and so once the $BROCB$ goes out of bounds above or below, it stays out of bounds.

with the number of agents who choose crime as the best response. Similarly, we do not require at this point that the tax rate τ is consistent with P and J in the sense of budget balance. We will define an equilibrium occupational choice boundary in the next section.

We begin by showing that higher ability agents choose more education and get more income as a result.

Lemma 1. (Education) *For a feasible state of the economy $(\tau, P, J, \mathcal{I}^c, e)$, the optimal level of education for an agent who chooses to be a worker is increasing in ability. In addition, higher ability agents choosing optimal educational levels earn more by working than would lower ability agents making optimal education choices.*

Proof. For an agent (a, h), the optimal educational level maximizes:

$$(1 - S(\kappa))(1 - \tau)\left[W_0 + W_1 ae - C(e)\right].$$

Differentiating it with respect to e yields,

$$W_1 a = \frac{\partial C(e)}{\partial e}, \tag{8}$$

which is independent of h. Recall that $C(e) \geq 0$, $C'(e) > 0$, and $C''(e) > 0$. Thus, for any two agents (a, h) and $(\overline{a}, \overline{h})$ such that $a < \overline{a}$, if we assume that both agents work, the agent with the higher ability chooses a higher educational level, i.e., $(\overline{a}, \overline{h}) > e(a, h)$.

Moreover, since $(\overline{a}, \overline{h})$ could have chosen the same educational level as (a, h), but found a higher level to be optimal, it must also be that

$$W_0 + W_1 ae\left(\overline{a}, \overline{h}\right) - C(e(\overline{a}, \overline{h})) > W_0 + W_1 ae(a, h) - C(e(a, h)),$$

which proves the second part of the lemma. ■

This lemma allows us to show the next theorem which says that the $BROCB$ is a downward sloping line.

Theorem 1. (Occupational Choice Boundary) *For any state of the economy* (τ, P, J, I^c, e), $BROCB(a; \kappa; \tau, P, J)$ *is decreasing in* a*. Moreover, for all* $(\overline{a}, \overline{h}) \gg (a, h)$, $(\overline{a}, \overline{h}) \in I^w$ *and for all* $(\overline{a}, \overline{h}) \ll (a, h)$, $(\overline{a}, \overline{h}) \in I^c$.

Proof. Let $h = BROCB(a; \kappa; \tau, P, J)$, and take any $(\overline{a}, \overline{h}) \gg (a, h)$. By Lemma 1, agent $(\overline{a}, \overline{h})$ gets more compensation from working than (a, h). Now consider the compensation from choosing crime for each agent. The only thing that changes in the right-hand-side of equation (5) is that more honest agent discounts more heavily the proceeds from the crime committed by $1 - \overline{h} < 1 - h$. We conclude that work is strictly more attractive and crime strictly less attractive to agent $(\overline{a}, \overline{h})$ than (a, h).

Showing the opposite holds for any agent $(\overline{a}, \overline{h}) \ll (a, h)$ follows a completely parallel argument. ■

This implies that if an agent (a, h) is just indifferent between work and crime, all agents with higher abilities greater honesty choose to work and all agents with lesser ability and honesty choose to commit a crime. Thus, $\mathcal{I}^c$ is a comprehensive set, $\mathcal{I}^w$ is an inversely comprehensive set, and $BROCB$ is a downward sloping line separates the two.

4 Equilibrium

A feasible state $(\tau, P, J, \mathcal{I}^c, e)$ is an *Endogenous Sorting Equilibrium* (ESE) if

1. (educational choice) for all $(a, h) \in \mathcal{I}^w \equiv \mathcal{I} \setminus \mathcal{I}^c$, $e(a, h)$ is an optimal choice taking everything else as given, i.e., $e(a, h) \in \arg\max_e (1 - S(\kappa))(1 - \tau) [W_0 + W_1 ae - C(e)]$;

2. (occupational choice) for all $(a, h) \in \mathcal{I}^w$, $w(a, h) \geq \ell(a, h)$ and for all $(a, h) \in \mathcal{I}^c$, $w(a, h) \leq \ell(a, h)$;

3. (equilibrium sorting) $\int_0^1 BROCB(a; \kappa; \tau, P, J) da = \kappa = \mu(\mathcal{I}^c)$.

Note that this implies that taxes, police and jail expenditures (τ, P, J) are chosen exogenously. One could endogenize this to a political equilibrium, but we put this aside for now and make them policy variables determined by a social planner.

By definition, the crime rate is given by,

$$\kappa = K(\kappa) \equiv \int_0^1 BROCB(a; \kappa; \tau, P, J)da, \tag{9}$$

which constitutes a fixed-point mapping of κ. The *Equilibrium Occupational Choice Boundary* (OCB) can then be derived: $OCB(a; \tau, P, J)$. Under the normality condition stated above, $\frac{\partial K(\kappa)}{\partial \kappa} > 0$ and one may have multiple fixed points with those satisfying $\frac{\partial K(\kappa)}{\partial \kappa} < 1$ being stable. Figures 2A and 2B, respectively, plot the cases of a single stable interior ESE (point E) and two stable interior ESE's (points E_1 and E_2).

It is obviously that an all-crime equilibrium with $\kappa = 1$ can never exist, because in that case there would be no proceeds for the criminal to take away (which can also been seen from the fixed point mapping). However, there is always a no-crime equilibrium with $\kappa = 0$ given low proceeds or under severe punishments:

Theorem 2. (No-Crime Equilibrium) *For a feasible state of the economy* $(\tau, P, J, \mathcal{I}^c, e)$, *a no-crime endogenous sorting equilibrium with* $\kappa = 0$ *emerges as long as committing a crime is not too profitable.*

By "not too profitable", we mean that some combination of high punishment cost, high policing rates and low looting return rate $(S(\kappa))$ make crime a relatively unattractive choice. The consequence is we fall below a critical crime rate such that so few criminal remain to diffuse policing a punishment resources that no one ends up finding a life of crime a worthwhile choice. This result is shown by "guess and verify" by using equations (4), (5) and (9). Specifically, we show $\kappa = 0$ satisfies (9) and that at this point $w(a, h; \kappa; \tau, P, J) < \ell(a, h; \kappa; \tau, P, J)$.

Furthermore, a nondegenerate equilibrium may arise:

Theorem 3. (Nondegenerate Equilibrium) *For a feasible state of the economy* $(\tau, P, J, \mathcal{I}^c, e)$, *a nondegenerate endogenous sorting equilibrium with* $\kappa \in (0, 1)$ *exists when committing* *a crime is sufficiently profitable.*

From the discussion above the meaning of "sufficiently profitable" is obvious, and again the result is established by guess and verify.

It also turns out that a nondegenerate equilibrium may coexist with the no-crime equilibrium. We will establish this result by way of numerical examples in Section 5 (see Figures 2A and 2B).

We can use the framework developed so far to consider a number of policy questions. We conclude this section with several remarks in this spirit.

- **Targeting educational subsidies** First of all, it can never be Pareto improving to give educational subsidies to those who would choose to become workers in equilibrium. This is because agents pay for education with pretax income in this model, so they already equate the marginal benefit and marginal cost of education at an equilibrium. Providing a subsidy, therefore, induces them to obtain too much education. It also increases tax rates which make work less attractive and so may induce more agents to choose crime. On the other hand, national income must go down (since the marginal unit of education costs more than it produces) which implies that there is less loot and so crime is also less attractive. As a result, the net effect of these subsides on crime rate is unclear. Second, it may be Pareto improving to subsidize agents who would otherwise choose to become criminals in equilibrium. These agents do not internalize the benefits that reduced crime affords to existing workers and subsidizing education may induce them to become workers as well. The higher taxes required to pay for the subsidy, however, make work less attractive, all else equal, and so may induce existing workers to choose crime instead. The overall effect on crime rate is therefore also ambiguous. We nevertheless do learn something about the best place to target these subsidies if a society for whatever reason has decided to have them: they should be directed at agents who are high-ability (and so would use their education most productively) but who are dishonest and so might choose a life of crime if not given additional incentives. This suggests we should neither help the intellectually disadvantaged nor give merit-based scholarships. Instead we should use subsidies to encourage smart people with juvenile records to go to school. We certainly should not take away scholarships from students who have drug or other convictions since these are exactly the agents who are on the edge who might end up being a criminal burden to society if they do not have extra incentives to stay in school.

- **Implications for balanced and unbalanced growth and contractions** Another implication relates to unbalanced growth or contraction in an economy. If an economy grows in a balanced way with returns to both high and low-skill workers staying in the same proportion, there is nothing to induce a move away from current equilibrium crime rate. Crime and the formal sector remain equally attractive on the margin and so growth *per se* neither induces nor prevents crime. Symmetrically, recession and depression should not in themselves cause a social breakdown. On the other hand, if growth or contraction increases the rewards paid to high-skill workers or decreases those paid to low-skill ones disproportionately, it becomes relatively more attractive for low-ability workers to choose crime. This will increase the crime rate and may even cause the society to transit from a low crime to a high crime equilibrium. Thus, unbalanced growth can be seen as corrosive to social cohesion in the context of this general equilibrium crime model.

- **Enforcement and education choice in a dynamic context** So far, we have neglected dynamic considerations. Suppose we extend this model to consider agents who live many periods but choose a life path early on. This may introduce additional instabilities to the model. For example, in choosing educational levels, agents need to project what they think the likely rewards to being a worker over the course of their lives are likely to be. If all agents hold optimistic priors about the future, high educational levels are chosen, national income is high, and crime rates and taxes are low. Once an agent has chosen a low educational level, however, honest labor becomes permanently less attractive. It may also be difficult to join the labor force once one has committed crimes. Thus, if the government has an optimistic prediction about future growth, it may be in its interests to subsidize education to keep pessimistic agents from closing off their future as workers. It might also have more interest in vigorously enforcing laws against young agents to discourage irreversible criminal behavior and to be as less concerned about the actions of older workers who would lose only a few productive years in they turn to crime. This might be a justification for aggressive enforcement of laws against violent and drug crimes and relative mild punishments for white collar crimes.

5 Characterization

Since the ESE in the economy with two-dimensional heterogeneity is very difficult to characterize analytically, we will conduct numerical analyses to which we now turn. To be more concrete, let the education cost function be constant-elastic and the punishment cost function be linear:

$$C(e) = C_0 e^{1+\alpha} \quad \text{and} \quad \lambda(\frac{J}{\Pi\kappa}) = \lambda_0 \frac{J}{\Pi\kappa},$$

where $\alpha > 0$, $C_0 > 0$ and $\lambda_0 > 0$. We then write the educational choice function according to (8) as:

$$e = \varepsilon(a) \equiv \frac{W_1 a}{(1+\alpha)C_0}, \tag{10}$$

and the pre-tax, pre-crime net earned income as:

$$W_0 + W_1 ae - C(e) = W_0 + Ba^2 \tag{11}$$

where $B \equiv \frac{1}{C_0}\left(\frac{W_1}{1+\alpha}\right)^2$.Using (7) and (10), we can rewrite (1) as:

$$Y(\kappa) = \int_0^1 (1 - BROCB(a;\kappa;\tau,P,J))\left[W_0 + W_1 a\varepsilon(a) - C(\varepsilon(a))\right] da, \tag{12}$$

where from (6) and (7),

$$\begin{aligned}
& BROCB(a;\kappa;\tau,P,J) && (13)\\
= \; & \min\left\{1, \max\left\{0, 1-\frac{\lambda_0 J+(1-\tau)(1-S(\kappa))\kappa\left[W_0+W_1 a\varepsilon(a)-C(\varepsilon(a))\right]}{(1-\tau)S(\kappa)Y(\kappa)}\right\}\right\}.
\end{aligned}$$

It is clearly seen that $sign\left[\frac{\partial Y(\kappa)}{\partial\kappa}\right]=-sign\left[\frac{\partial BROCB(a;\kappa;\tau,P,J)}{\partial\kappa}\right]$. Substituting (11) and (13) into (12) and manipulating, we get:

$$\begin{aligned}
& Y(\kappa) && (14)\\
= \; & \left(\frac{1}{S(\kappa)}\int_0^1\left\{\frac{\lambda_0 J}{1-\tau}+(1-S(\kappa))\kappa\left[W_0+W_1 ae-C(e)\right]\right\}\left[W_0+ae-C(e)\right]da\right)^{1/2}\\
= \; & \left[\Upsilon_1\frac{1}{S(\kappa)}+\Upsilon_2(1-S(\kappa))\kappa\right]^{1/2}
\end{aligned}$$

where

$$\begin{aligned}
\Upsilon_1 &\equiv \frac{\lambda_0 J}{(1-\tau)}\left[W_0+\frac{1}{3C_0}\left(\frac{W_1}{2}\right)^2\right]\\
\Upsilon_2 &\equiv (W_0)^2+\frac{2W_0}{3C_0}\left(\frac{W_1}{2}\right)^2+\frac{1}{5}\left(\frac{1}{C_0}\right)^2\left(\frac{W_1}{2}\right)^4
\end{aligned}$$

Using (11) and (14), we can rewrite (13) to obtain:

$$\begin{aligned}
& BROCB(a;\kappa;\tau,P,J) && (15)\\
= \; & \min\left\{1, \max\left\{0, 1-\frac{\lambda_0 J+(1-\tau)(1-S(\kappa))\kappa\left(W_0+Ba^2\right)}{(1-\tau)S(\kappa)^{1/2}\left[\Upsilon_1+\Upsilon_2(1-S(\kappa))\kappa S(\kappa)\right]^{1/2}}\right\}\right\}
\end{aligned}$$

One can easily show $\frac{\partial BROCB(a;\kappa;\tau,P,J)}{\partial a}<0$ (i.e., downward sloping $BROCB$). Yet, the sign of $\frac{\partial BROCB(a;\kappa;\tau,P,J)}{\partial\kappa}$ remains ambiguous. If the functional form of the fraction of social wealth stolen from workers is so chosen to satisfy $\frac{\partial[(1-S(\kappa))\kappa]}{\partial\kappa}<0<\frac{\partial[(1-S(\kappa))\kappa S(\kappa)]}{\partial\kappa}$, however, one can establish: $\frac{\partial Y(\kappa)}{\partial\kappa}<0$ and $\frac{\partial BROCB(a;\kappa;\tau,P,J)}{\partial\kappa}>0$ for the interior range $BROCB(a;\kappa;\tau,P,J)\in(0,1)$. Intuitively, this is a case where a "normality condition" is imposed so that crime is harmful for the society's aggregate income. In this case, there exists a $\kappa_{\min}$ such that $BROCB(a;\kappa;\tau,P,J)=0$ for all $\kappa<\kappa_{\min}$. Moreover, even as $\kappa\longrightarrow 1$, we have: $BROCB(a;\kappa;\tau,P,J)=1-\frac{\lambda_0 J+(1-\tau)(1-S(1))\left(W_0+Ba^2\right)}{(1-\tau)S(1)^{1/2}\left[\Upsilon_1+\Upsilon_2(1-S(1))S(1)\right]^{1/2}}<1$.

We now specify further the arrest probability as

$$\Pi(\kappa, P) = 1 - \frac{\kappa^\delta}{\beta + \gamma P},$$

where $\beta > 0$, $\gamma > 0$ and $\delta \in (0, 1)$. We then specify the fraction of social wealth stolen from honest workers as

$$S(\kappa) = 1 - (1 + \sigma)^{-\kappa},$$

where $\sigma > 0$. We next set in the benchmark case: $\alpha = 1$, $C_0 = 1$, $\beta = 1$, $\gamma = 0.5$, $\sigma = 2.5$, $\lambda_0 = 0.01$, $\delta = 0.5$, $W_0 = 10$, $W_1 = 2$, $\tau = 0.2$, and $J = 0.5$. Under these parameter values, a no-crime equilibrium always exists. Moreover, the OCB is relatively flat, as given in Figure 3, where all agents with $h < 0.118$ become criminals and those with $h > .159$ work in the formal sector. Thus, the benchmark interior crime rate is 14.5% and the coexistence of a no-crime equilibrium and a nondegenerate equilibrium is verified.

By performing comparative statics around the nondegenerate equilibrium (see Figure 3), we can establish an array of results.

- **What happens if there is an exogenous reduction in the cost of education C or an increase in the variable wage W_1?** From (6), it is clear that all agents who work choose higher educational levels and as a consequence, aggregate income increases. This latter effect implies crime is also more attractive, so the crime rate (κ) may go up or down.

- **What happens if the fixed wage W_0 increases?** This is more complicated than a reduction in C – to be more concrete, let consider an increasing in W_0 from 10 to 15. This causes the OCB to rotate counter-clockwise (flatter). While less able agents ($a < 0.54$) are induced to work in the formal sector, more able ones are discouraged as national income increases and crime therefore becomes more attractive. Compared to the case of education cost reduction, this creates an additional channel of ambiguity with respect to the net change in the crime rate.

- **What happens if rewards to crime (σ) or punishment cost (λ_0) changes?** We find that the crime rate is most responsive to changes in σ, which measures the the relative size of the proceeds: nothing (all) can be stolen as $\sigma \longrightarrow 0$ ($\sigma \longrightarrow \infty$). When we increase σ from 2.5 to 3 and 4, respectively, the society's crime rate rises to 21.0 and 30.5 percent; as σ goes down to 2, the crime rate drops to 5.5%. If we further reduce σ to 1.9, the no-crime equilibrium emerges as the only equilibrium outcome. Just opposite to σ, higher values of λ_0 will shift the OCB inward and reduce the crime rate, because an increase in the punishment cost facing the criminals discourages criminal activity. Raising λ_0 from 0.01 to 0.15 is sufficient to remove anyone's incentive to commit a crime.

- **What can we say about the crime deterrence policies?** Consider an exercise where the expenditure on policing P or the expenditure on jails J increases. While educational levels do not change, chances of getting caught and punished for crime are higher but taxes must also go up to maintain government balanced budget. Thus, crime is less attractive, but work may be more or less attractive. So again the crime rate may go up or down, though within reasonable parameter range, the deterrence effect is always present (i.e., κ reduces). Yet, can we shed light on which deterrence policy is more effective? Consider a budget-balancing shift in crime policy from $(\tau, P, J) = (0.2, 1.46, 0.5)$ to $(\tau, P, J) = (0.2, 0.96, 1)$, that is, from more police enforcement to jail punishment. The overall crime rate changes only slightly, decreasing from 14.5% to 14.2%, with the OCB shift inward uniformly.

6 Concluding Remarks

In this paper, we consider an economy with a continuum of agents who have heterogeneous abilities and ethics. Agents must choose between acquiring education and becoming workers or forgoing education and becoming criminals. The model is closed in the sense that all loot stolen by the criminals must be produced by the workers who must also pay for any enforcement and punishment efforts through an income tax. As a result there are both positive and negative spillovers between criminals: positive as criminals draw police attention from one another, and negative as criminals must divide their fraction of the national product among all agents who share their occupational choice.

We show that high and low crime equilibria can exist for the same set of parameters. We also show that the indifference boundary in ability-honesty characteristic space is downward sloping. Thus, high ability people find the formal sector more attractive than low ability people of the same ethical level. This implies, for example, that the average accountant is likely to be less fundamentally honest than the average convenience store clerk.

The model allows us to consider a number of policy questions. It suggests: (1) That scholarships given on basis of merit may be socially wasteful since high ability agents chose to work and make optimal education choices already. (2) Scholarships that induce agents who would have chosen a life of crime to go to school instead can be socially beneficial. (3) Growth or contractions that affect all members of a society equally have no implication for equilibrium crime rates. (4) Unbalanced growth or contraction that help the rich or hurt the poor disproportionately may lead to social breakdown.

There are many directions that this work might be extended, though the most interesting might be to add dynamic considerations formally. For example, consider an overlapping generations version of this model in which the ethical level of agents is influenced by their peers and education choices made in early life affect work opportunities in latter life. Both of these effects lead to instabilities and tendency for agents with even small differences in their abilities and backgrounds to strongly diverge in their life choices. The vicious cycle of children raised in crime-ridden neighborhoods being more crime-prone and making irreversible decisions to dropout of school and subsequently finding crime more attractive than work in latter life may therefore emerge. (Children with the same characteristics but in better neighborhoods might be on the other side of the OCB and have radically different life paths). This would have strong implications for social policy (such as busing innercity kids to wealthy suburbs and imposing very aggressive law enforcement in poor neighborhoods) Similarly, policies to manage unbalanced growth to prevent social breakdown and bring countries in transition or who have experienced social breakdown back to order and growth could be explored in a dynamic context. The closing of the model, which introduces new and interesting feedbacks, and the inclusion of ethics and values, especially as they emerge dynamically, opens new and more realistic avenues to refine our understanding of these issues.

References

[1] Becker, Gary S. (1968), “Crime and Punishment: An Economic Approach,” *Journal of Political Economy*, 76, 169-217.

[2] Block, Michael K. and John M. Heineke (1975), ”A Labor Theoretic Analysis of Criminal Choice,” *American Economic Review,* 65, 314-325.

[3] Burdett, Kenneth, Lagos, Ricardo, and Randall Wright (2003),“Crime, Inequality, and Unemployment,” *American Economic Review* (forthcoming).

[4] Davis, Michael L. (1988), “Time and Punishment:An Intertemporal Model of Crime,” *Journal of Political Economy*, 96, 383-390.

[5] Ehrlich, Isaac (1973), “Participation in Illegitimate Activities: A Theoretical and Empirical Investigation,” *Journal of Political Economy*, 83, 521-565.

[6] Freeman, Scott, Jeffrey Grogger and Jon Sonstelie (1996), “The Spatial Concentration of Crime,” *Journal of Urban Economics*, 40, 216-231.

[7] Glaeser, Edward L., Bruce Sacerdote, and A. Scheinkman (1996), “Crime and Social Interactions,” *Quarterly Journal of Economics*, 111, 507-548.

[8] Gould, Eric, David Mustard and Bruce Weinberg (2002), “Crime Rates and Local Labor Market Opportunities in the United States, 1979-97,” *Review of Economics and Statistics*, 84, 45-61.

[9] Grogger, Jeff (1998), “Market Wages and Youth Crime,” *Journal of Labor Economics*, 16, 756-791.

[10] Huang, Chien-Chieh, Derek Laing and Ping Wang (2003), “Crime and Poverty: A Search-Theoretic Approach,” *International Economic Review* (forthcoming).

[11] İmrohoroğlu, Ayse, Antonio Merlo, and Peter Rupert (2000*a*), “On the Political Economy of Income Redistribution and Crime, “ *International Economic Review*, 41, 1-25.

[12] İmrohoroğlu, Ayse, Antonio Merlo, and Peter Rupert (2000*b*) ”What Accounts for the Decline in Crime?,” Working Paper, Federal Reserve Bank of Cleveland.

[13] Lochner, Lance (1999), "Education, Work and Crime: Theory and Evidence," Working Paper, University of Rochester.

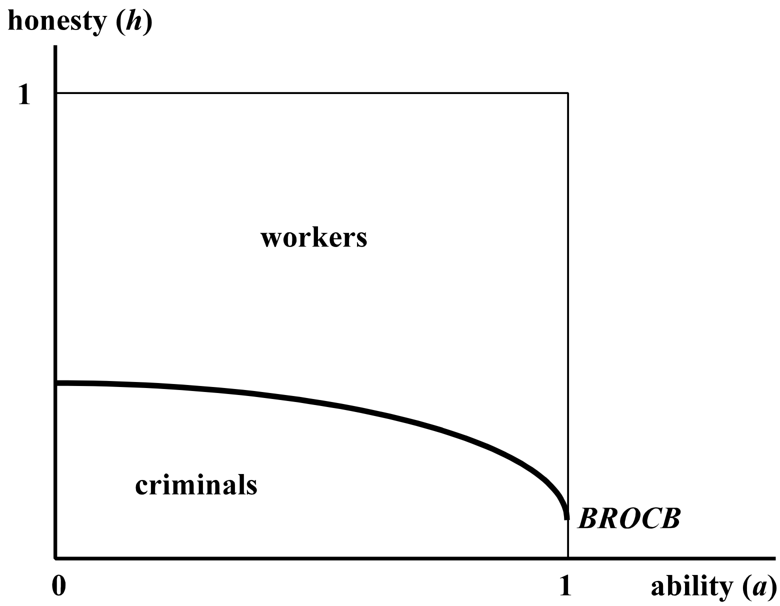
[14] Rasmusen, Eric (1996), "Stigma and Self-Fulfilling Expectations of Criminality," *Journal of Law and Economics*, 24, 519-543.

[15] Sah, Raaj K. (1991), "Social Osmosis and Patterns of Crime," *Journal of Political Economy*, 94, 1272-1295.

[16] Witte, Ann Dryden and Helen Tauchen (1994), "Work and Crime: An Exploration Using Panel Data," NBER Working Paper no. 4794, Cambridge, MA.

Figure 1. Best Response Occupational Choice Boundary (*BROCB*)

A. The Benchmark Case



B. An Alternative Case

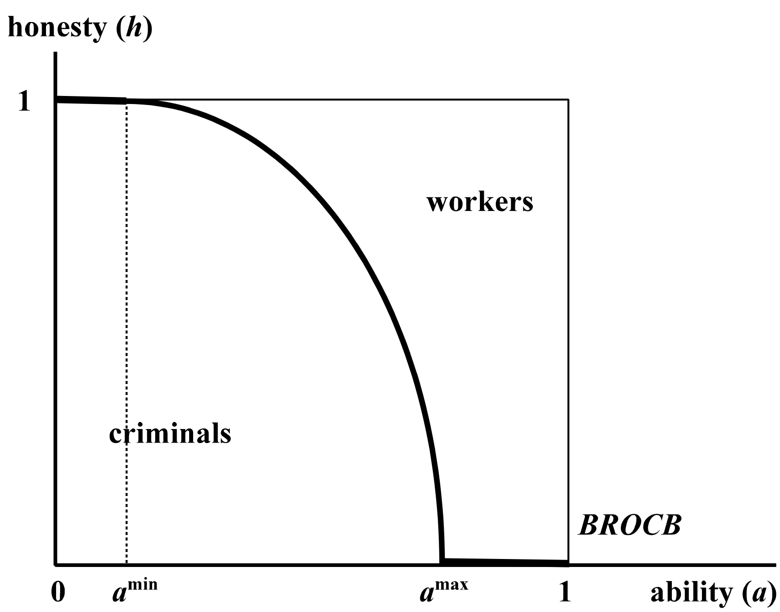
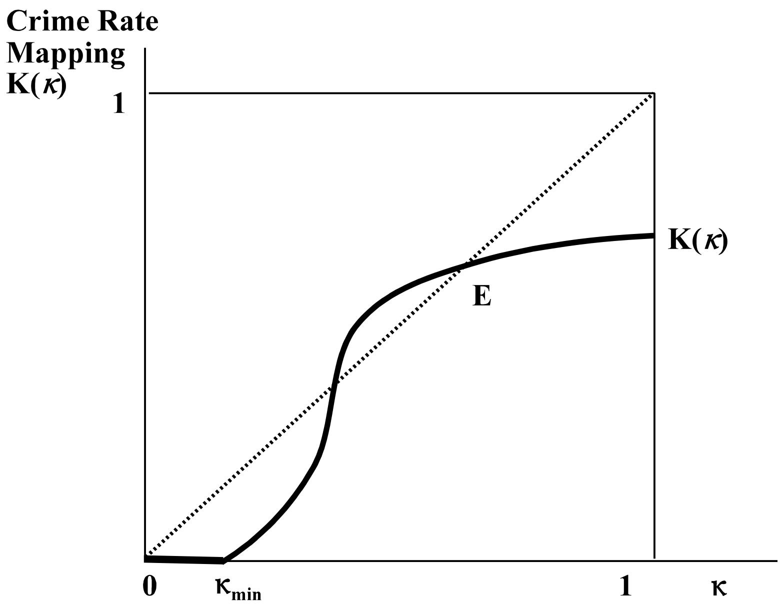


Figure 2. Equilibrium Crime Rate

A. Unique Interior Equilibrium



B. Multiple Interior Equilibria

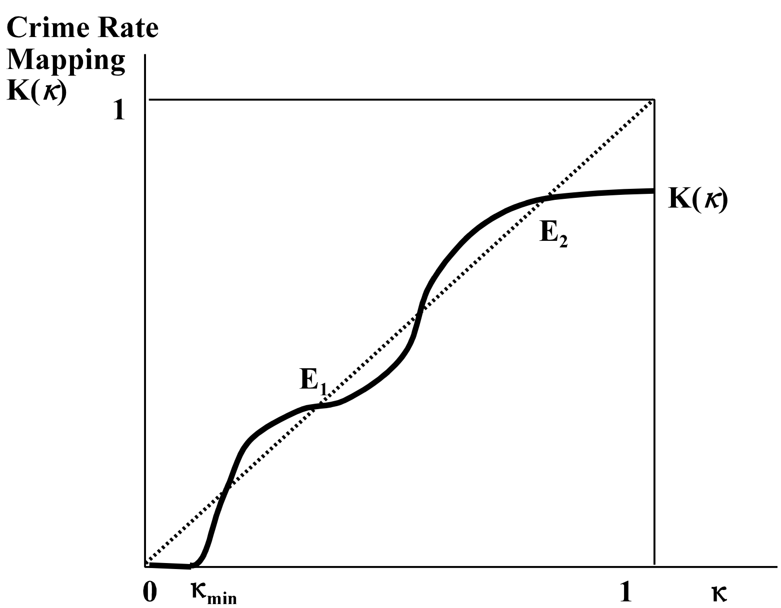


Figure 3. Changes in Equilibrium Occupational Choice Boundary (*OCB*) in Response to Parameter Shifts