Stichting Onderzoek Wereldvoedselvoorziening van de Vrije Universiteit

Centre for World Food Studies

The emergence of crime under decollectivization: a general equilibrium argument

by

M.A. Keyzer

Staff Working Paper **WP - 02 - 06** April 2002

Contents

Abstract

The paper formulates a static general equilibrium model in which crime is represented as a unilaterally enforced income transfer. Individuals choose between an honest and a criminal career while investing in prevention to avoid robbery or arrest. We explore the conditions under which the criminal career becomes unattractive. We show, without recurring to higher penalties, better competition and improvement of employment opportunities, and under a broad class of market distortions, that crime is eliminated if individual robbers are obliged to share the proceeds with their peers, while the robbed also share their losses, essentially because this taxes away their gains. Conversely, the individualization of incentives under decollectivization is seen to disrupt this redistribution mechanism and hence to foster crime.

Section 1
Introduction[1]

The high-days of individualized incentives during the 1990s revealed the dangers of decollectivization, especially in situations where the legal framework is weak initially or dismantled in the course of the process, as became particularly clear in Africa and in parts of the former Soviet Union (Aron, 2000; World Bank, 2000). As in the wake of a natural disaster or a war, decommissioned soldiers become tempted to engage in crime, as they have developed the necessarily predatory skills to threaten and attack, while their work experience in the regular economy has become obsolete. Unemployed graduates, workers whose factories have been destroyed, farmers whose herds were stolen and lands degraded or confiscated face similar temptation.

Failure of prosecution

Whereas historians study both the rise and the fall of economic systems, economic theorists tend to focus on equilibria that are either socially desirable or on the contrary constitute a social trap to which development paths converge and from which escape is difficult. They usually focus on economic progress, fluctuation or stagnation, but the erosion and gradual destabilization of prevailing equilibria has received much less attention. Becker's (1968) celebrated paper on law enforcement belongs to the progressist tradition. It started a branch of micro-economics that was seeking to determine socially optimal levels of fines and non-monetary sanctions as well as expenditures on apprehension (for surveys see Garoupa, 1997; Polinsky and Shavell, 2000).

Whereas in the standard competitive model, social optimality (first-best) is synonymous to Pareto efficiency, the law enforcement literature uses the concept in a more restrictive sense, since it requires, in addition, that all agents acquire their goods in a legal way. It distinguishes between productive and predatory careers and considers a Pareto efficient allocation to be first-best (or non-aggressive) if no individual is a predator (see e.g. Grossman and Kim, 1995). The aim is to design a schedule of punishments that is sufficiently harsh to deter all potential offenders, as this permits to save on protection, apprehension and imprisonment. The analysis generally proceeds from the perspective of the representative agent, or of the agent with the greatest propensity to commit crime, and since the aim is to find a ideal solution in which no one chooses to be a criminal, this hardly acts as a limitation. Since the framework is static, it can also be used to identify necessary conditions for first-best, and conversely, to identify the causes of failure through these.

[1] The author thanks Inge Keijspers and Ferdinand Pavel for comments and suggestions

Furthermore, recent papers allow for humanitarian considerations that restrict harshness, as well as for errors in detection and costs of prosecution and imprisonment. Then, first-best becomes unattainable and the need arises to strike a balance between the amount of resources devoted to prosecution and imprisonment, and the level of fines and non-monetary punishments, as it no longer suffices to announce draconian penalties that deter perfectly well and hence do not have to be carried out. In fact, in this second-best situation equilibria may be multiple. For example, in the model by Fender (1999), individuals maximize expected revenue, while knowing with certainty the income they would earn as criminals. This income follows a given distribution around the fixed wage earned in an honest career, while probability of capture depends on the resources spent on prosecution, and on the number of criminals. It appears that a low crime equilibrium with few criminals and a high probability of capture may coexist with a high crime equilibrium where the converse holds. An exogenous shock such as a war or a natural disaster might cause the economy to shift from the low to the high crime equilibrium.

Lack of opportunities and failure of democracy and competition

Rather than treating crime as a plague that can be eradicated, the development literature tends to view it as a reality. The number of youngsters enlisting in a criminal career will rise when the employment in the regular economy deteriorates (Grogger, 1997; Raphael and Winter-Ebner, 2001). Civil servants may seek a supplement to their salaries by formally or informally auctioning licenses that are kept in short supply and more blatant forms of corruption are not uncommon (Grossman and Helpman, 1994, Hellman et al. 2000, Kaufmann et al., 1999). While some papers recognize the social function of corruption as a way of rewarding the employees and of speeding up the bureaucratic process (Lui, 1985; Bardhan, 1997), most authors generally identify lack of free entry, competition, transparency and democracy as the basis for the market power of the offenders. These factors are also evoked to explain poor economic performance especially because resources invested in political capital depreciate much faster than those invested in physical and human capital (Ehrlich and Lui, 1999). Thus, lack of opportunities to earn income by honest means as well as failures in administering the remedies of criminal punishment, competition and democracy can cause crime to proliferate.

Decollectivization

In this paper, we call attention to a fourth remedy, the collective redistribution of earnings within a local community such as the extended family or the village and claim that privatization and market oriented reform has unduly neglected this aspect.

In a nutshell, our approach runs as follows. Because crime causes harm and implies a waste of resources both in its execution and its prevention, a Pareto efficient equilibrium will generally do without it. By the Second Welfare Theorem, this solution can be decentralized as a competitive equilibrium with transfers. The common view, expressed in the Washington consensus, is that to implement this equilibrium, the focus should lie on the establishment of competitive markets with adequate protection of individual property rights. Transfers play only a marginal role, because their lump sum implementation is considered too difficult in practice. Donors are reluctant to disburse them, since they have experienced that recipients tend to become aid dependent and locked within poverty traps.

Be this as it may, in many parts of the world the task of protecting individual property rights appears to be even more difficult. In fact, the reluctance to recognize the importance of lumpsum transfers might express a cultural bias of the North, since in the extended families and village communities of the developing world transfer mechanisms abound that come very close to lump sum (see e.g. Ilahi and Jafarey, 1999). The collectives in centrally planned countries had similar features. Some of them were formal entities, others consisted of informal rings. The units that could marshal sufficient monopoly power survived and grew, while those that depended on state subsidies and lacked control over a vital product perished (Braguinsky, 1999). These distribution mechanisms deserve special attention, because they can function effectively without requiring a central government and judiciary to protect property rights, and because the ongoing process of privatization and individualization may cause their dismantling or their turning into criminal organizations.

From the perspective of incentive compatibility, the reasoning is that the competitive equilibrium from welfare theory is efficient because it enables individuals to behave independently, so that all receive full marginal reward for their efforts. But this holds for productive as well as for predatory behavior. Our paper aims at showing within a general equilibrium model that the disincentive effects of collectivization in production also apply to crime, basically because the lump sum redistribution of revenue from crime that is achieved through its collectivization tends to eliminate it.

A general equilibrium model

Our model extends the standard general equilibrium model of perfect competition in four respects.

First, to explain that some choose for crime while others stay honest, we consider various groups of homogeneous individuals who freely choose their career given the prices and employment opportunities in the economy. We maintain a high degree of symmetry in our treatment of the different agents. All individuals are potentially both prey and predator, the criminals conduct armed robbery to collect from honest people, but honest people can arrest robbers.

Second, the model generates lump sum transfers by *ex post* pooling at group level of all revenue from non-productive origin. *Ex ante* pooling is equivalent to a mutual insurance scheme, whereby participants pool the expected value of the revenue and redistribute it so as to keep expected revenue equal to expected outlays. By contrast, *ex post* pooling places far less demands on the institutional environment, since it only requires the revenue in every state to be pooled and balance with the state-specific outlays and there is no need to maintain solidarity between winners and losers or to enforce earlier contracts. The main idea is that when financial punishment and rewards are pooled either *ex ante* or *ex post* over larger units, say, an extended family or a village, they operate like lump sum transfers and hence no longer affect the choice of career. Pooling avoids that group members focus their efforts on capturing rents rather than working for their wages. In other words, while it is well understood that revenue pooling creates free riding, and therefore discourages work effort and savings, the analysis points out that it also discourages crime. Conversely, elimination of free riding by decollectivization and privatization stimulates crime. It appears that the property does not depend on the absence of distortions in the economy, as long as these are not career-specific. The property also holds if larger collectives of criminals benefit from gains of concentration in robbing but it breaks down as soon as criminals can supply regular goods, say, goods that have been declared illicit, or when they start enjoying the career in itself. Yet, under these conditions the model to be presented can still be used to assess the effect of tighter punishment and better regular employment.

Third, victims of crime and prisoners can have satiated utility functions, as financial compensation for injuries might be pointless or impossible.

Finally, we account for the fact that by spending resources on prevention, individuals can affect their probability of being robbed or arrested. Hence, this probability becomes endogenous, as in health economics (Zweifel and Breyer, 1997; Hurley, 2000). In their model of criminal behavior, Bliss and Di Tella (1997) also allow for prevention but they note that this causes a non-convexity in the agent’s expected utility function. The endogenous probability is seen as the fraction of people reaching a particular state, and hence as a constrained migration decision where like in Dasgupta and Ray (1986), Srinivasan (1994) and Keyzer (1995), a lottery chooses between identical individuals. By treating prevention as a regular production process, we can show that the non-convexity becomes innocuous since the model has well behaved reaction functions, nonetheless.

Imrohoglu et al. (2000) also use a general equilibrium framework to represent crime as a choice of career, with expenditures on apprehension and protection but their model seeks to formulate empirical hypotheses about crime in the United States and contains very specific assumptions on sequential voting about police expenditures and the skill deficiencies of criminals. By contrast, we proceed within an applied general equilibrium framework as in Ginsbugh and Keyzer (1997) to conduct scenario simulations rather than econometric estimations. This allows for empirical applications with a detailed representation of the economy under study, and avoids simplifications such as the assumption that only the less talented opt for crime.

The main conclusion from our model will be that if criminals are taken to supply − directly via sale as well as indirectly via inputs into the production technology − less value to the consumer than honest people, and if both groups form collectives that effectuate lump-sum redistribution of net proceeds from theft, then in equilibrium crime will be eliminated. In fact, since by this property all threats vanish, and hence, no need for prevention, the result holds for almost any specification of theft, threats and prevention, including technologies with increasing returns to scale.

Overview

The paper proceeds as follows. Section 2 considers the career choice of individual members of a homogeneous group and identifies conditions under which no one chooses a criminal career. Next, we look for representations of a social planning problem that would be compatible with this behavior of individuals. Section 3 focuses on the inclusion of the threats to represent the endogenous determination of the probability that an honest person will be robbed and that a robber will be captured. Section 4 extends this probability generating mechanism with a technology of prevention, whereby goods can be used to reduce the threats. In section 5, we specify individual budget equations which lead to individual decisions that support such a plan. Section 6 incorporates various distortions on the consumer and producer side, and shows that crime will be eliminated, nonetheless, as long as these distortions are not career-specific and fall within a specified range. Section 7 concludes.

Section 2
Individual choice of career

We distinguish homogeneous groups of individuals indexed $i = 1, \ldots, I$. Every individual belongs to one, relatively large and perfectly homogeneous group i, and faces the choice between an honest and a criminal career, indexed $r = 1,2$ with $r = 1$ associated with an honest career. The weight variable w_{ir} denotes the choice for career r. There is a given probability P_{ir}^{s} for members from group i having chosen r to end up in state s, for $s = 1, 2$ denoting the state of safety and unsafety, respectively. For the honest individual, being robbed is an unsafe state, whereas for the criminal it is arrest that is to be avoided. In the models to be presented, extension of the number of careers and states creates no difficulty as long as there is at least one honest career and one safe state.

Within every group i, there is, for every combination rs, one collective that shares proceeds on an *ex post* basis. Hence, individuals receive the net per capita transfer h_{irs} as lump sum, from the pooled net revenue of the collective they eventually belong to. Changing career does not alter this because the other group members are taken to stay where they are. For ease of exposition, and to stress that punishment does not play a central role in the model, we abstract from fines.

There are K goods in the economy. Every individual in irs sells fixed endowments e_{ir} and consumes quantity c_{irs}, at a given price p, where e_{ir} and c_{irs} are K-dimensional column vectors and p is an K-dimensional row vector.[2] Consumption c_{irs} yields utility $u_{irs}(c_{irs})$.

Given the fact that the distribution of transfers is being regulated by the group as collective, and supposing that all other members of group i are known to have chosen career $\bar{r}_i$, and that their number is large, the transfer can be taken as given and career-independent. Since all members are identical the incentive to hide earnings is actually limited because the difference in expenditures can be observed by the others. The individual consumer now takes transfers as given and faces two budget constraints, one for every state. The choice of career w_{ir} by an individual from this group is determined by:

$$
\begin{aligned}
&\max_{c_{irs}\geq 0, w_{ir}\geq 0, all\ rs} \textstyle\sum_r w_{ir} \sum_s P_{ir}^{s} u_{irs}(c_{irs}) \\
&\qquad \textstyle\sum_r w_{ir}\, pc_{irs} = \sum_r w_{ir}\, pe_{ir} + h_{i\bar{r}_i s} \qquad\qquad (1a)\\
&\qquad \textstyle\sum_r w_{ir} = 1
\end{aligned}
$$

with the equilibrium condition that the given index $\bar{r}_i$ satisfies:

$$\bar{r}_i = r \text{ if } w_{ir} = 1 \text{ is optimal in (1a).} \qquad (1b)$$

[2] We take all price vectors to be row variables to avoid vector transposes, for ease of notation.

In this model, no one will choose a career in crime, if this career is less rewarding than honesty. Hence, our first proposition ensuring absence of crime reads:

Proposition 1 (Avoiding an unproductive career). *In consumer model (1a), with net transfers satisfying (1b), assume that the expected utility is not higher in a criminal career than in the honest one:* $\sum_s P_{i2}^s u_{i2s}(x) \leq \sum_s P_{i1}^s u_{i1s}(x)$*; (b) the criminal career is strictly unproductive in the sense that it yields in both states a lower probability weighted value of endowments career:* $P_{i2}^s pe_{i2} < P_{i1}^s pe_{i1}$*, for s = 1,2; (c) for all career and state combinations both states are feasible:* $P_{i1}^s pe_{i1} + h_{i1s} > 0$ *for s = 1,2, and* $h_{i21} \geq 0$*; and (d) fines imposed on captured criminals and redistributed to honest people in safety are zero:* $h_{i11} = h_{i22} = 0$*. Then, expected utility maximizing individuals will not choose crime as a career.*

Proof. Because of the homogeneity of degree one with respect to w_{ir}, it follows that because by (c), the budget constraint of (1a) can be met, the optimum in (1a) satisfies $w_{i1} = 1$ or $w_{i2} = 1$. Therefore, we may replace (1b) by the equilibrium condition:

$$h_{i\bar{r}_i s} = h_{is}(w_{i1}, w_{i2}) = \sum_r w_{ir} h_{irs} \,, \tag{1c}$$

for given h_{irs}. Program (1a) defines the optimal correspondence $w_{ir}(h_{i1}, h_{i2})$ and (1c) the function $h_{is}(w_{i1}, w_{i2})$. The solution of (1a), (1c) is a fixed point of the composition that maps w_{ir} from the two-dimensional simplex into itself. By Kakutani's fixed point theorem, such a solution exists. Now in (1a) every individual specializes on the honest career, because by (a) and (b) its expected utility is highest.

We note that by assumption (a) the probability of arrest of criminals should not be too low, say, higher than the probability of being robbed, and the treatment in prison not too favorable, as compared to the situation of the victims. Assumption (b) indicates that the criminal's revenue from (honest) sale of endowments is lower. In section 2.4 below, we specify robberies for which condition (c) applies. We also note that the elimination of crime holds independently of any efficiency properties of the economy as a whole. This is due to assumption (b), which basically amounts to requiring that criminals supply less of every commodity than honest people.

As mentioned earlier, the career-independent sharing of revenue from theft plays the key role, since keeps individuals insulated from bad incentives. This redistribution is purely *ad hoc*. It could for instance be adapted to represent within-group insurance but we abstract from insurance to highlight that it is not necessary for the result. Similarly, it would be straightforward to redistribute proceeds over several groups according to some institutional arrangement. This would also permit to account for within-group heterogeneity. However, limiting the collective to a homogeneous group is least demanding from an institutional perspective because it implies zero net transfers among the members of each collective.

Section 3
Crime and arrest as a threat

The next step is to articulate conditions under which assumption (b) of proposition 1 holds, that is to identify conditions under which in an economy with collective redistribution of net proceeds from theft, the market forces make it unattractive to engage in crime.

In fact, we relax assumption (b) and allow criminals to supply less of some endowments. They might possess weapons, or be very strong physically, or know special tactics which could enable them to be highly effective bodyguards. Therefore, we want to show that despite the presence of assets that only become valuable in a criminal career, a Pareto efficient economy shifts prices and resources in a direction where honesty yields higher revenue in all states.

Consequently, we need to represent explicitly the effort required to commit a crime, and the threat posed by it. We distinguish two types of goods: regular $k \in K_1$ and irregular; N_i is the fixed number of members of group i, and n_{irs} the variable number of individuals in irs. The career choice is now seen as a migration decision. Only regular goods provide utility, while $U_{is} = \sum_r n_{irs} u_{irs}(c_{irs})$ denotes the population weighted per capita utility of group i in state s. The no crime result still holds if abstraction is made of irregular goods but we maintain these goods to allow for the many commodities and skills that can only be used in a criminal career.

The threat of robbery or arrest is a determinant of the probability of occurrence of a particular state. This is represented by the scalar function $T_{ir}^{ir}(n_{ir1}, N_{ir})$, that is convex, homogeneous of degree one, and nondecreasing, where $\boldsymbol{ir}$ denotes the group and career causing the threat, and $N_{ir} = \sum_s n_{irs}$ the number of members of group i choosing career r. Hence, all threats are independent and the probability $P_{ir}^s = n_{irs} / N_{ir}$, $s = 2$ of becoming a victim is bounded from below by $\sum_{ir} T_{ir}^{ir}(n_{ir1} / N_{ir}, 1)$, i.e. is the sum of threats by the different groups, each of which depends on the ratio of the predator to the prey population. This implies that probability is taken to be objective and the risk idiosyncratic: there is no threat of robbery if no one is being robbed and since the fractions are deterministic, uncertainty only prevails at the level of the individual. This formulation could readily account for traditional feuds and no aggression pacts between, say, ethnic, groups, while replacement of the summation over aggressors ir by another form would permit to represent alliances and other interactions.

Proposition 2 (crime and arrest as a threat). *Suppose that:*

(a) *no one enjoys a criminal career: the utility function $u_{irs}(c_{irs})$ is homogeneous, concave and increasing in regular goods; non-regular goods do not enter as arguments; and $u_{i2s}(c) \leq u_{i1s}(c)$;*

(b) *no one enjoys falling victim to crime or arrest: $u_{ir1}(c) \geq u_{ir2}(c)$ for any c;*

(c) *supply is expressed as fixed, state-independent endowment* e_{irk} *; honest people do not use up any good and they supply a regular good in positive amounts:* $e_{i1k} \geq 0$ *for all* $k \in K_1$ *and* $e_{i1k} > 0$*, for some* $k \in K_1$ *;*

(d) *criminals are unproductive in their supply of regular goods:* $e_{i2k} < e_{i1k}$ *for* $k \in K_1$ *;*

(e) *if all agents choose honesty, there is no threat of robbery or arrest:* $T_{i1}^{i1}(n_{i11}/N_{i1},1) < 0$*; and there is a threat when there is any criminal out of jail:* $T_{i1}^{i2}(n_{i21}// N_{i1},1) > 0$ *if* $n_{i21} > 0$ *.*

(f) *no goods are illicit: there are no penalties on consumption;*

(g) *there exists an equilibrium* $n_{irs}^*, N_{ir}^*, c_{irs}^*, U_{is}^*$*, for*

$$
\begin{aligned}
&\textit{Threat:} && n_{ir2} \geq \sum_{ir} T_{ir}^{ir}(n_{ir1}, N_{ir}) \\
&\textit{Population balance:} && N_{ir} = \sum_s n_{irs} \\
& && \sum_{rs} n_{irs} = N_i \\
&\textit{Commodity balance:} && \sum_{irs} n_{irs} c_{irs} \leq \sum_{ir} N_{ir} e_{ir} \\
&\textit{Group utility:} && U_{is} = \sum_r n_{irs} u_{irs}(c_{irs})
\end{aligned}
$$

(h) *this equilibrium is Pareto efficient in terms of state specific group utility* U_{is} *.*

Then, there is no crime in equilibrium.

Proof. First, we prove that Pareto efficiency implies, in equilibrium, maximization of the weighted sum of utilities $\sum_{is} a_{is} U_{is}$, for some given, positive weights a_{is}. To derive these weights, suppose that U_{is}^* is positive for $i = 1$. If this is not the case, label another group as $i = 1$; if there was none, no consumer would use any of the regular good, contradicting Pareto efficiency. Suppose that it has $s = s_0$.Next, we can maximize utility for this group $i = 1$, while including the bounds $U_{is} \geq U_{is}^*$ for $(i,s) \neq (1,s_0)$ and treating the restrictions in (g) as constraints. This inclusion must be feasible since an equilibrium solution was taken to exist. Pareto efficiency implies that $U_{1s_0} = U_{1s_0}^*$ and the equilibrium is an optimum of this program. Moreover, the Lagrange multipliers associated to the bounds can be interpreted as welfare weights a_{is}, while $a_{1s_0} = 1$. Secondly, to prove that there is no crime in equilibrium, suppose the converse: $n_{i2s} > 0$ for any *is*. Then, shifting all individuals of every group i to honesty, $r = 1$, would by (c)-(d) permit to raise the availability of the regular good, and by (a)-(b) it would not cause a drop in utility for any group, contradicting optimality. Therefore, there is no crime in equilibrium.

In terms of by individuals in model (1a-b) the migration flows determine the probabilities $P_{ir}^s = n_{irs}/N_{ir}$ according to:

$$P_{ir}^{2} = \sum_{ir} T_{ir}^{ir}\,(n_{ir1} / N_{ir}\ ,1)\,, \qquad (3)$$
$$P_{ir}^{1} = 1 - P_{ir}^{2}\,.$$

We also observe that in condition (c), there is for criminals no sign restriction on the endowment of irregular goods. They might supply these in positive quantity, offering security services at a price; but they might also use them up, thus making the marketed surplus smaller, as leisure would reduce the marketed supply of labor. Similarly, there is no sign restriction on the use of regular goods. This allows for the use of physical inputs to effectuate the threat. Finally, while the model treats the number of individuals as a real as opposed to an integer variable, the no-crime property also holds in case the number of individuals is discrete, since the real-valued optimum $n_{i11} = N_i$ inherits the integer-valuedness of N_i .

The proposition says, that the safe state of the honest career has probability one, and all other probabilities are zero. Relative to Proposition 1, the main conclusion from this proposition is that even if we allow the criminals to be highly productive in their supply of irregular goods, and to receive, as a collective, all their revenue from theft, Pareto efficiency implies, nonetheless, that no one will be moved to such a career, because, not surprisingly, the technique of bringing people into insecurity is unrewarding from a welfare perspective. Clearly, the next step is to show that for an explicit structure of theft and prosecution, and with a threat structure as in (2) individuals will end up in such a Pareto efficient equilibrium. We return to this in section 5.

Finally, the convexity and homogeneity assumptions on the threat functions could be dispensed of, since the proof did not invoke them. Therefore, the model could represent various non-convexities, so as to represent the economies of scale and scope in the criminal sector. The convexity assumptions only play a role when we seek to decentralize the optimum, in section 5 below and, since there is no crime in the optimum, the functions are inactivated and do not need inclusion in the decision problems of the individuals. In fact, any functional form that meets assumption (e) could be applied, including a specification with commodity inputs as further arguments. Nonetheless, we maintain the stated assumptions because they permit to adapt the model to situations where crime is not eliminated. The same applies to the prevention technology to be introduced in the next section.

Section 4
Including prevention in the welfare program

We extend the model to allow for use of the irregular good as input in prevention of crime and arrest. Endogenizing this physical cost strengthens the efficiency gains from elimination of crime, since there is no need to incur them when there are no criminals. We suppose that prevention uses inputs D_{ir} of both the regular and the irregular good, and for a population N_{ir} of potential victims in ir, lead to a reduction $Q_{ir}(D_{ir}, N_{ir})$ in the number of victims n_{irs} for $s = 2$. This is a standard production function, that could exhibit returns to scale but for the reasons just mentioned we take it to be concave, homogeneous of degree one, and nondecreasing in inputs.

Proposition 3 (Threat and prevention). Let conditions (a)-(f) and (h) of Proposition2 hold and amend (g) as follows:

(g) there exists an equilibrium $n^*_{irs}, N^*_{ir}, c^*_{irs}, D^*_{ir}, U^*_{is}$, for

$$\begin{array}{lll}
\text{Threat:} & n_{ir2} \geq \sum_i T^{i2}_{ir}(n_{i21}, N_{ir}) - Q_{ir}(D_{ir}, N_{ir}) & \\
\text{Population balance:} & N_{ir} = \sum_s n_{irs} & \\
 & \sum_{rs} n_{irs} = N_i & \\
\text{Commodity balance:} & \sum_{irs} n_{irs} c_{irs} + \sum_{ir} D_{ir} \leq \sum_{ir} N_{ir} e_{ir} & (4) \\
\text{Group utility:} & U_{is} = \sum_r n_{irs} u_{irs}(c_{irs}) &
\end{array}$$

Then, there is no crime in equilibrium.

Proof. By the same argument as in the proof of Proposition 2, there exists a welfare optimum, for choice variables $c_{irs}, n_{irs}, D_{ir}, N_{ir}$, such that:

$$\max_{c_{irs}, D_{ir} \geq 0,\, n_{irs}, N_{ir} \geq 0, \text{all } irs} \sum_{irs} a_{is} n_{irs} u_{irs}(c_{irs})$$

$$\text{subject to}$$

$$\begin{array}{ll}
\sum_{irs} n_{irs} c_{irs} + \sum_{ir} D_{ir} \leq \sum_{ir} N_{ir} e_{ir} & \\
n_{ir2} \geq \sum_{ir} T^{ir}_{ir}(n_{ir1}, N_{ir}) - Q_{ir}(D_{ir}, N_{ir}) & (5) \\
N_{ir} = \sum_s n_{irs} & \\
\sum_r N_{ir} = N_i &
\end{array}$$

The zero-crime property can be verified as before: any solution with crime could be improved upon by one without it, and can, therefore, not be a welfare optimum.

Recall that Pareto efficiency is always defined in terms of the wellbeing of specified agents. If crime is eliminated the equilibrium is Pareto efficient in terms of the utility U_{is}, i.e. for agents *is*. Clearly, if the welfare weight in program (5) was *r*-specific, crime might persist and the optimum would only be Pareto efficient in terms of the career specific utility U_{irs}, i.e. for agents *irs*. Conversely, in case of perfect insurance across states and careers the welfare weights would become equal across states and careers and Pareto efficiency would hold for the expected utility of every agent *i*, whereas *if* the collective broke up and individuals had access to career-specific insurance, this would be the expected utility of agents *ir*, illustrating that institutional deficiencies find expression in reduced co-ordination.

At this point a side remark may be in order. Whenever crime is considered an unproductive activity, one would expect that it should, in a welfare theoretic setting, be possible to offer sufficient side payments to anyone considering a crime, so as to maintain safety in society, i.e. to share in the "dividend of peace". But then, everyone could claim to be a potential criminal and extract revenue from others. Hence, side payments can only be envisaged if there is an a priori subdivision between criminals and non-criminals, and the criminals receiving payment give up all possibilities to recidivate in the future, e.g. by surrendering while delivering their arms or going into exile. Conversely, if all keep the option open of becoming a criminal, the compensation approach does not work and crime will only disappear when it becomes unattractive.

Section 5
Individual career decisions and equilibrium

We return to individual decisions, as in (1a), and specify a model that supports the Pareto efficient equilibrium of Proposition 3, now making the nature of the crime explicit. Conditions (a)-(b) only stated that crime does not make anyone's life better in utility terms, and conditions (c)-(d) that it even makes it worse as far as production is concerned, hence its elimination from any welfare optimum. We now explicitly state that the crime consists of theft, possibly together with the infliction of injuries, and that punishment consists of imprisonment or forced labor (as in Proposition 1, we abstract from fines). We establish the decentralization of the welfare optimum, by making use of the well known equivalence between a welfare optimum and a competitive equilibrium (Negishi, 1960), and obtain Pareto efficiency as a property of the equilibrium.

In line with consumer model (1a) and pursuing the approach in program (5), where weights are group and state specific but not career-specific, we impose one budget constraint by i for every state s. Criminals of group i rob a nonnegative, variable fraction $x_{ir}^{ir}(p_1,...,p_i,...,p_I)$ from each of their victims in ir, for $r=2$, where $p_i = N_{i2}/N_i$, is the share of robbers in the total population of group i. As in Proposition 1, fines are zero: $x_{ir}^{ir}(p_1,...,p_i,...,p_I)$ for $r=1$. These robbing functions are continuous and homogeneous and satisfy: $\sum_i x_{ir}^{i2}(\cdot)<1$, to ensure that they leave positive income after theft, whereas $x_{ir}^{ir}(p_1,...,p_i,...,p_I)=0$ whenever $p_i=0$, to reflect that there are no proceeds accruing to group i if this group has no thieves. The net transfer can now be obtained by defining the appropriate revenue pools, as follows:

(1) honest people are being robbed:

$$H_{irs} = -\left(\sum_i x_{ir}^{i2}(\cdot)\right) N_{ir}\, m_{ir}\,, \qquad r=1;\ s=2; \tag{6a}$$

(2) criminals in safety redistribute the pooled revenue from theft, *ex post*:

$$H_{irs} = \sum_{ir} x_{ir}^{ir}(\cdot) N_{ir}\ m_{ir}\,, \qquad r=2;\ s=1 \tag{6b}$$

(3) fines are zero and criminals do not fall victim of robbery:[3]

$$H_{irs} = 0\,, \qquad r=2;\ s=2; \tag{6c}$$

[3] Alternatively, positive fines could be introduced but they would have to be imposed collectively on all captured criminals. It would also be possible to extend this to collective punishment of the whole group i under both states. This would equivalent to an imperfect insurance mechanism whereby captured and non-captured criminals share the punishment on a uniform per capita base. Perfect insurance would also act as lump sum, but it would adjust the payments so as to equalize marginal utility, and hence, welfare weights across states.

(4) and, hence, no fines are available for redistribution to honest people in safety

$$H_{irs} = 0 \,, \qquad\qquad r = 1;\ s = 1. \tag{6d}$$

Finally, sales of endowments constitute the basis for transfers:

$$m_{ir} = pe_{ir} \,. \tag{6e}$$

The problem for the individual could be written, as in (1a), with given probabilities of robbery and arrest P_{ir}^{s}. Indeed, since there is to be no crime in equilibrium we could further simplify formulation (1a), with $P_{ir}^{s} = 1$ for $s = 1$, and $r = 1$ and $P_{ir}^{s} = 0$ otherwise. Yet, our aim is to give a specification that would still be meaningful when we relax the assumptions that guarantee elimination of crime. Here we present a formulation in which individuals take the threat as given but decide about prevention on their own. This means that they take the net loss from robbery or arrest as given, but have the individual capacity to affect the probability of these events.

Hence, we neglect the external effect from threats and it is noteworthy that we prove Pareto-efficiency despite this imperfection. The effect may be neglected because the individual member has no incentive to engage in threats towards members of other groups because of the sharing of any gains with a large collective, and possibly also because it might be technically difficult to execute a one-man robbery. Conversely, there is no point in anticipating strategically the impact of the own decision on the probability of theft or arrest, since this effect is negligible. By the same token, decollectivization creates room for individual action, and may require accounting for the external effect of threats. Also, when the collective survives, but conditions are such that crime is immanent, say, because there is no exit, it may operate strategically, and anticipate external effects. In short, if the model was to be used in situations where crime persists, it might have to be extended to accommodate more elaborate planning procedures by collectives and individuals but here we neglect all external effects and write the individual's program as:

$$\begin{aligned}
&\max_{c_{irs}, d_{ir} \geq 0, P_{ir}^{s}, w_{ir} \geq 0, all\ rs} \textstyle\sum_{rs} w_{ir} P_{ir}^{s} u_{irs}(c_{irs}) \\
&\text{subject to} \\
&\quad p\left(\textstyle\sum_{rs} w_{ir} c_{irs} + \sum_{r} w_{ir} d_{ir}\right) \leq p \sum_{r} w_{ir} e_{ir} + h_{i\bar{r}_i s} \\
&\quad P_{ir}^{2} \geq \bar{P}_{ir}^{2} - Q_{ir}(d_{ir}, 1) \\
&\quad \textstyle\sum_{s} P_{ir}^{s} = 1 \\
&\quad \textstyle\sum_{r} w_{ir} = 1
\end{aligned} \tag{6f}$$

for given

$$\bar{P}_{ir}^{2} = \textstyle\sum_{ir} T_{ir}^{ir}(n_{ir1}/N_{ir}, 1), \text{ where } n_{irs} = P_{ir}^{s} w_{ir} N_i, \text{ and } N_{ir} = \sum_{s} n_{irs} \tag{6g}$$

and

$$\bar{r}_i = r \text{ if } w_{ir} = 1 \text{ is optimal, while } h_{i\bar{r}_i s} = \frac{H_{i\bar{r}_i s}}{n_{i\bar{r}_i s}} \tag{6h}$$

and prices p, which are normalized on the simplex, are such that commodity balances hold:

$$\sum_{ir} \sum_s n_{irs} c_{irs} + \sum_{ir} N_{ir} d_{ir} \leq \sum_{ir} N_{ir} e_{ir} \tag{6i}$$

The specification can be interpreted along the same lines as the equilibrium (1a)-(1b). We have formulated a model for which, in equilibrium, every member of a group has chosen the same career. Because of the assumed institutional obligation on every criminal to pool all revenue from theft, and on the honest citizen to share in the loss from robbery of the fellow honest citizen in the same group, transfers become lump sum and the individual takes them as given.

Because of the ex post pooling the budget restriction in (6f) is career-independent. Hence, we can establish compatibility with the optimum of welfare program (5) whose welfare weight is career independent as well. To avoid the inherent discontinuities of per capita variables such as the transfers in (6h) and to ensure concavity of the welfare program, we express the model in aggregate variables at the level of the collective. For this, we also need a further limit restriction in condition (a) because to permit decentralization of the social optimum in (5), continuity of the objective must be ensured. The proposition reads:

Proposition 4 (Equilibrium without crime). Let (b)-(f) hold as in Proposition 3. Amend (a) to:
(a') No one enjoys a criminal career: the utility function $u_{irs}(c_{irs})$ is homogeneous, concave increasing in the regular good and $u_{i2s}(c_{i2s}) \leq u_{i1s}(c_{i1s})$; $\lim_{n\downarrow 0} n\, u_{irs}(c/n) = 0$ for any given x, and $u_{irs}(0/0) = 0$ by convention. Then, under conditions (a')-(f), there exist prices p such that (6a-i) holds and solve (5).

Proof. The proof proceeds in two steps. First, to apply the Negishi approach, we must establish concavity of an equivalent program. We define aggregate demand $C_{irs} = c_{irs} n_{irs}$ and utility $U_{irs}(C_{irs}, n_{irs}) = n_{irs} u_{irs}(c_{irs}, n_{irs})$ of the collective. By Theorem A.1.5 in Ginsburgh and Keyzer (1997) this function is concave, strictly quasiconcave. We can now rewrite the program (5) as:

$$\max_{C_{irs}, D_{ir} \geq 0, n_{irs}, N_{ir} \geq 0, \text{all } irs} \sum_{irs} a_{is} U_{irs}(C_{irs}, n_{irs})$$

subject to

$$\sum_{irs} C_{irs} + \sum_{ir} D_{ir} \leq \sum_{ir} N_{ir} e_{ir} \qquad (p)$$

$$n_{ir2} \geq \sum_{ir} T_{ir}^{ir}(n_{ir1}, N_{ir}) - Q_{ir}(D_{ir}, N_{ir}) \qquad (t_{ir})$$

$$N_{ir} = \sum_s n_{irs} \qquad (f_{ir})$$

$$\sum_r N_{ir} = N_i, \qquad (r_i)$$

with welfare weights on a unit simplex. From Proposition 3 follows that $n_{irs} = N_i$ for $r = 1$ and $s = 1$ and $n_{irs} = 0$ otherwise. Hence, unfeasibility cannot occur, irrespective of the negative entries for endowments in a criminal career and it is possible to follow the Negishi approach of adjusting welfare weights welfare weights a_{is}, normalized on the simplex so that each member *is* has zero budget deficit. (see e.g. Ginsburgh and Keyzer, 1997, chapter 3). Since by assumption (e) $T^{i1}_{i1}(\cdot) < 0$ it follows that $t_{ir} = 0$. Therefore, the external effects from threats can be neglected in the budget constraint of (6f). For every collective, and given the price *p* obtained as Lagrange multiplier of the commodity balance, the aggregate budget deficits B_{is} can be calculated from the optimal solution of the welfare program,:

$$B_{is} = \sum_r \left(pC_{irs} + pD_{ir} - pN_{ir} e_{ir} - H_{irs} \right),$$

with H_{irs} defined by (6a-e). For these aggregate variables it follows by standard fixed point arguments that the welfare weights exist. Third, we verify that this Negishi equilibrium is an equilibrium of model (6a-i). The welfare weight is positive for every group *is* with positive n_{irs}, because incomes are positive by the assumption on transfers, and a zero expenditure would therefore imply a budget surplus, contradicting the Negishi equilibrium. Then, as the strict concavity assumptions guarantee uniqueness of the allocation, it follows, by the second welfare theorem, that this optimumal allocation of the welfare program (5) also solves (6a-i), after renormalization of prices to the simplex.

We recall that the common sharing of the losses from robbery is not a true insurance scheme, because all participants suffer the same loss, so that in equilibrium the payments of within group compensations vanish. Similarly, the sharing of revenue from the robbery implies no actual transfer among the robbers. In short, the collective affects incentives rather than redistribution.

We also note that if the collectives could invest in strengthening their capacity to extort incomes, the result would hold, nonetheless, as long as all collectives remain merely rule-based devices to pool and redistribute earnings from theft. Somewhat paradoxically, the efficiency property depends on the non-cooperative free riding behavior of the members of the collective with respect to the determination of transfers. In other words, this model exhibits the property that co-operation creates a welfare distortion, even when the collective does not act strategically.

By contrast, if transfers were career dependent in (6f), every individual would experience marginal returns from moving to a criminal career, and crime might not be eliminated, illustrating that decollectivization fosters crime. Thus, also somewhat paradoxically, elimination of crime requires on the one hand that criminals are relatively inefficient in their contribution to the regular part of the production sphere, but on the other hand that they are well integrated within collectives of their own. This touches upon the question as to why it is that the disruption of the state causes robbery to flourish. The model suggests that the robbers' reduced fear of arrest is at best part of the answer, since one might object that these robbers could offer their services as guards or choose to work in the regular economy. Indeed, in our model the loss of discipline among the soldiers and militias is the key factor that makes it attractive for them to opt for crime, because through it all looting becomes decentralized to small groups, viz. individuals.

Finally, if any collective could overcome free riding and started deciding co-operatively as an optimizing agent, it could internalize restriction (6h′) and members might be sent to the criminal career, even under perfect insurance and if all externalities were accounted for. Hence, improved co-ordination, possibly as a result of the breaking up of a larger collective into more manageable sub-units, or because of better leadership, is seen to create situations very similar to those of decollectivization.[4]

Possible modifications

The budget constraint in the consumer problem supposes that prevention is rival: all individuals decide privately about prevention, in the same way as about consumption. One modification would be to treat inputs in prevention as a non-rival, and organize Lindahl pricing for it at group level. This would be particularly simple in this case, since all members are identical and the Lindahl prices coincide with market prices. Moreover, this nonrival consumption could be interpreted as being public. In this case, the number N_{ir} could be looked at as a vote within collective *i* for a purchase D_{ir}. However, if the provision of the public good was decided upon at a higher level, say, by all honest people simultaneously, the representation of democratic voting would necessitate to correct for difference in welfare weights, so as to maintain equal weight for every voter. This would amount to a consumer specific subsidy of the type discussed in the next section.

Another straightforward modification would be to analyze the situation without theft: $x_{ir}^{ir} = 0$. In this case, the criminals in the model possibly cause injuries, reflected through strict inequality in assumption (b), and definitely spend less effort on the production of regular goods, as indicated in assumption (d). These injuries would trigger expenditures on prevention, by both the criminal and the potential victims. This in turn would provide the individual criminals with an opportunity to earn income from the supply of protection services and reflects the situation where the protection of private property rights is “safely” in the hands of criminals, while extortion is the only source of criminal revenue, described in Braguinsky (1999). However, under the prevailing assumptions are modified, no one would opt for this career, because in the absence of further market imperfections, this would not pay.

[4] The effect of strategic behavior can be incorporated in the welfare program by means of the price wedges to be considered in the next section (cf. Ginsburgh and Keyzer, chapter 11).

Section 6
Market imperfections

In this section, we explore whether the no-crime property is preserved when career-independent market imperfections such as indirect taxes, tariffs on trade, monopoly premiums, rents are accounted for. Market imperfections may also relate to informational deficiencies such as deviations of subjective from objective probabilities. It is important to consider this case because crime is obviously at odds with perfect competition. Within a welfare format, all these market imperfections can be represented through additional terms in the welfare objective.[5] We consider wedges x_{is} on consumption, respectively and write the welfare program in terms of the aggregate variables of Proposition 4 as:

$$
\begin{aligned}
&\max_{C_{irs}, D_{ir} \geq 0, n_{irs}, N_{ir} \geq 0, \text{all } irs} \textstyle\sum_{irs} (a_{is} U_{irs}(C_{irs}, n_{irs}) + x_{is} C_{irs}) \\
&\textit{subject to} \\
&\textstyle\sum_{irs} C_{irs} + \sum_{ir} D_{ir} \leq \sum_{ir} N_{ir} e_{ir} \qquad (p) \\
&n_{ir2} \geq \textstyle\sum_{ir} T^{ir}_{ir}(n_{ir1}, N_{ir}) - Q_{ir}(D_{ir}, N_{ir}) \\
&N_{ir} = \textstyle\sum_s n_{irs} \\
&\textstyle\sum_r N_{ir} = N_i,
\end{aligned}
\tag{7}
$$

with clearing price p as Lagrange multiplier associated to the commodity balance. As long as the wedges remain above some lowe r bound, so as to keep the objective nonstationary and non-decreasing in (C_{irs}, n_{irs}), the line of argument in the proof of proposition applies and crime will be eliminated, essentially because honesty yields higher welfare. This amounts to requiring that the consumer subsidy x_{is} should not become so negative as to rule out all consumption in the honest career: $a_{i1} \frac{\partial u_{ir1}}{\partial c_{ir1k}} + x_{i1k} > 0$, for some k; negative subsidies may reflect taxes as well as monopoly premiums. We postpone the formulation of a proposition until the model will have been extended to cover current production.

Production

So far, current production was excluded from the model and all endowments were taken to be fixed. As labor would usually be considered part of the commodity vector, this implies that the work effort of individual workers-consumers was supposed to remain constant. In practice

[5] See Ginsburgh and Keyzer (1997), chapters 5, 6 and 11for the representation of taxes, ration schemes and imperfect competition, respectively. Wedges on probability judgements would enter as weights on n in the objective.

information asymmetries are known to prevail that may cause absenteeism and shirking and the drive towards privatization and individualization was to a large extent motivated by the lack and inappropriateness of production incentives under collective arrangements. We can represent these as distortions that create a wedge between the producer price of net output and the market price, while maintaining the assumption of profit maximization, which in this situation only amounts to supposing that net output lies on the boundary of the production possibility frontier. This makes it easy to incorporate current production in the models of the earlier sections. For this, we consider firms indexed $j = 1, \ldots, J$ and denote by y_j the net commodity supply of firm j. We also consider, for every firm j, the convex production cone Y_j with constant returns to scale.[6] Profit maximization at tax- and distortion-ridden prices p^y by every firm j is written:

$$max_{y_j \in Y_j} \; p_j^y y_j . \tag{8a}$$

Because of constant returns, every profit maximizing firm makes zero profit in equilibrium, while rents are collected as price wedges or accrue to endowments. Hence, there is no need to redistribute profits. However, the proceeds from the wedges need redistribution and the budget equations must also be modified to distinguish consumer from endowment prices. Hence (6f) becomes:

$$\begin{aligned}
&max_{c_{irs}, d_{ir} \geq 0, P_{ir}^s, w_{ir} \geq 0, all\ rs} \sum_{rs} w_{ir} P_{ir}^s u_{irs}(c_{irs}) \\
&subject\ to \\
&\quad p_{is}^c \left(\sum_r w_{ir} c_{irs} + \sum_r w_{ir} d_{ir} \right) \leq p \sum_r w_{ir} e_{ir} + h_{i\bar{r}_i s} + g_{is} \qquad (l_{is}) \\
&\quad P_{ir}^2 \geq \bar{P}_{ir}^2 - Q_{ir}(d_{ir}, 1) \\
&\quad \sum_s P_{ir}^s = 1 \\
&\quad \sum_r w_{ir} = 1 .
\end{aligned} \tag{8b}$$

The total proceeds from the wedges are

$$G = \sum_{is} x_{is} \left(\sum_r n_{irs} c_{irs} \right) + \sum_j y_j y_j \tag{8c}$$

and shared among collectives according to the tax functions:

$$G_{is} = f_{is}(V_{11}, \ldots, V_{is}, \ldots, V_{I2}, G) , \tag{8d}$$

where V_{is} is the income before tax and after redistribution of proceeds from theft.

$$V_{is} = \sum_r \left(N_{ir} m_{ir} + H_{irs} \right) \tag{8e}$$

[6] If $y \in Y$, then $l y \in Y$, for any nonnegative scalar λ.

The functions $f_{is}(\cdot)$ are continuous, homogeneous of degree one and such that after tax income is positive $V_{is} + G_{is} > 0$, and $G \leq \sum_{is} G_{is}$, while taxes $G = \sum_{is} G_{is}$ balance if $\sum_{is} V_{is} + G > 0$. Also $g_{is} = G_{is} / \sum_r n_{irs}$, for all G and nonnegative V. Finally, the consumer and producer price are determined as:

$$p^c_{is} = p + x_{is}(f, p, V_{is} + G_{is}) \tag{8f}$$
$$p^y_j = p + y_j(f, p, V_{is} + G_{is}), \tag{8g}$$

according to continuous functions that are homogeneous in f and homogeneous of degree one in $(p, V_{is} + G_{is})$.

The proposition below supposes that wedges are not "too large", because for high positive wedges (subsidies) it may happen that no equilibrium exists, as their financing would lead to negative income for some consumer groups, whereas, as discussed earlier, for negative wedges, the monotonicity of the welfare criterion is at risk, and through this, the elimination of crime.

Proposition 5 (Distorted equilibrium without crime). Let the assumptions of Proposition 4 apply. *Then, if* $y_{jk} \geq 0$ *for* $k \in K_1$ *and* $y_{jk} = 0$ *for* $k \notin K_1$, *there exists a positive range* $[0, \bar{f}]$ *and prices p, normalized according to the price wedges, such that (6a-e,g-i),(8a-g) hold.*

Proof. The introduction of wedges y_j on production is the only extension required for the associated welfare program (7), which becomes:

$$\max_{C_{irs}, D_{ir} \geq 0, n_{irs}, N_{ir} \geq 0, y_j \in Y_j, all\ irsj} \sum_{irs} (a_{is} U_{irs}(C_{irs}, n_{irs}) + x_{is}(C_{irs} + D_{ir}) + y_j y_j)$$
subject to
$$\sum_{irs} C_{irs} + \sum_{ir} D_{ir} \leq \sum_{ir} N_{ir} e_{ir} + \sum_j y_j \qquad (p)$$
$$n_{ir2} \geq \sum_{ir} T^{ir}_{ir}(n_{ir1}, N_{ir}) - Q_{ir}(D_{ir}, N_{ir}) \qquad (t_{ir})$$
$$N_{ir} = \sum_s n_{irs}$$
$$\sum_r N_{ir} = N_i,$$

with collective-specific budget deficits:

$$B_{is} = \sum_r \left(p^c C_{irs} + p^c D_{ir} - p N_{ir} e_{ir} - H_{irs} \right) - G_{is}.$$

The tax redistribution functions guarantee that income after tax is positive for all a_{is} on the simplex. Normalization on the simplex is possible since the functions (8d-f) are homogeneous of degree one. Because all *is* have positive after tax income and functions (8d-g) are continuous, a fixed point mapping of a compact convex set into itself can be constructed (as in Ginsburgh and Keyzer, 1997, chapter 5) and an equilibrium exists. And since the wedges are continuous functions of f, there is a positive range $[0,\bar{f}]$ for which negative wedges are sufficiently small to preserve the monotonicity property of the welfare criterion w.r.t. C_{irs} and n_{irs}. Furthermore, the sign-restriction on y_j ensures that the expansion in net output of regular goods made possible by a shift from crime to no crime receives an additional reward. Hence, on the basis of the same argument as in the proof of proposition 3 we conclude that crime is eliminated.

This proposition needs further comment.

First, once all threats have disappeared, we have $t_{ir} = 0$ as Lagrange multiplier in program (9). Now the first-order conditions imply that $a_{is} u_{is}(c_{irs}) = pe_{ir}$ if $n_{irs} > 0$. Therefore, n_{irs} is positive only for the career that yields maximal value of endowments, as in Proposition 1.

Second, the sign restriction on producer wedges y_j is obviously met when these wedges are absent. Hence, the crime fighting perspective would seem to offer some justification for the market oriented reforms that reduce wedges on intermediate deliveries while keeping the tax basis limited to final demand and primary factors. Clearly, reduction of subsidies on production and consumption of regular goods, which used to be common in East block countries, may improve economic efficiency and alleviate the stress on public finance but it appears that this could be conducive to crime, especially if monopoly premiums, bribes and excises are rising in the process and if collective arrangements that used to include rules for sharing “informal” income are being broken up.

Third, the proposition suggests that a “feudal” society whose public revenue is collected from excise and monopoly premiums can eliminate crime, as long as the central authority exercises moderation and has the power to pool the returns and market prices are the same for robbers and honest people.

Fourth, allowing for career-specific wedges, or for career-specific commodity balances, introduces further distortions and opens a possibility for individuals to move to locations with their own, possibly favorable tax regimes, that could operate as a safe haven for crime. This confirms that the fight against crime naturally conflicts with the principle of territorial sovereignty. It also indicates that free trade may be helpful in this fight, because it tends to equalize prices.

Fifth, we can infer from program (9) that technological improvements in the production of regular goods can, like subsidies on production, improve the attractiveness of honest careers. The first-order conditions of this program can also be used to calculate by how much the endowments of honest careers should rise relative to those of criminal careers so as to make crime unattractive.

Sixth, besides punishment and better opportunities, the model suggests a third way of getting rid of all crime: make everyone a criminal and there will be no one to rob. Obviously, this solution is only possible because of the simplifying assumption in equation (6e) that criminals are not being robbed. It is a straightforward extension to relax this rule and if conditions are such that crime persists, the economy may become trapped in an equilibrium where everyone engages in robbery while investing in prevention. In this situation, the collective could become an impediment to security, because the lump sum mechanism that makes it less attractive to enter crime now inhibits the reverse transition to honesty.

Finally, once crime persists, the model can be used to study the effect of centrally implemented law enforcement policies. This can be done by imposing an upper bound on the number of captured criminals. The multiplier associated to this bound defines a career-specific wedge z_{irs} on n_{irs} for $r = 2$ and $s = 2$ and measures the fine necessary to support it, which will include the premium t_{ir} to cover the external effect of threats. If the imposition of this wedge is taken to require additional physical inputs, as cost of apprehension and incarceration, the demand for these has to appear on the commodity balance. The proceeds from these fines should, after subtraction of the additional costs, be redistributed to consumers. The fine can also be interpreted as expressing a loss in marginal utility and hence the increase in severity of the prison regime, which could be costless. The new equilibrium will account for endogenous effects on prevention, as well as on the distribution of utilities, and it might happen that the protection services become so scarce that the utility of the non-captured criminals is actually seen to improve.

Section 7
Conclusion

Whereas the collective may be deficient in its transmission of incentives to individuals, it surely exercises an inhibiting force, referred to by Hobbes (1995) as “the power of the rest”. Every individual, even the strongest dictator, is physically weak against a coalition of opponents. Therefore, everyone must reach agreement with the surrounding individuals, to secure a minimum of personal safety. Such an agreement creates some form of collective, say, a gang, a family, a clan, a village or a state, governed by a set of formal or informal rules. Each collective may in turn fit within a higher entity with its own rules. The literature has emphasized the importance of institutional arrangements and described their evolution and transformation, but so far little seems to be known about the substitutability between national, local and family institutions. This is a subject for further investigation.

Stability analysis is another subject for future investigation. The choice of career could be looked at as a strategy choice in non-cooperative game theory, and because the utility payoff is linear homogeneous in these strategies, the individual best reply correspondence from prices and transfers to strategies will be set valued. Consequently, the equilibria could be as unstable and non-robust as in matrix games (see e.g. Kohlberg and Mertens, 1986; Govindar and Wilson, 2001). Both a situation with low or zero crime and a situation with high crime could be unstable. It would appear that with zero crime the career choice is fixed. However, the choice could be sensitive to small perturbations because, for honest people, the fear of punishment is an institutionalized deterrent from becoming a criminal, but in the absence of crime, there is no mechanism to preserve a minimal fear of being robbed and hence no incentive to invest in prevention. Hence, for low crime there is in this model a need for institutional arrangements that maintain security, even in the absence of objective threats. One possibility might be to commit minimal public expenditures on prevention, another to create fears among the population so as to trigger such expenditures. For high crime situations, the arms race between predators and preys can be a source of instability that may cause the equilibrium to settle at highly different levels of entrenchment, even after small shocks. This calls for an analysis with a dynamic version of the model that searches for a balance between stability and efficiency under alternative modes of expectation.

References

Aron, J. (2000) 'Growth and institutions: A review of the evidence', *World Bank Research Observer*, 115: 99 -135.

Bardhan, P. (1997) 'Corruption and development: a review of issues', *Journal of Economic Literature*, 35: 1320-1346.

Becker, G.S. (1968) 'Crime and Punishment: an economic approach', *Journal of Political Economy*, 76: 169 -217.

Bliss, Ch., and R. di Tella (1997) 'Does competition kill corruption?', *Journal of Political Economy*, 105: 1001-1023.

Braguinsky, S. (1999) 'Enforcement of property rights during the Russian transition: problems and some approaches to a new liberal solution', *Journal of Legal Studies*, 28:515-543.

Dasgupta, P., and D. Ray (1986) 'Inequality as determinant of malnutrition and unemployment: Theory', *Economic Journal*, 96: 1011-34.

Ehrlich, I., and F.T. Lui (1999) 'Bureaucratic corruption and endogenous economic growth', *Journal of Political Economy*, 107S: 270-293.

Fender, J. (1999) 'A general equilibrium model of crime and punishment', *Journal of Economic Behavior and Organization*, 39: 437-453.

Garoupa, N. (1997) 'The theory of optimal law enforcement', *Journal of Economic Surveys*, 11: 267-295.

Ginsburgh, V., and M.A. Keyzer (1997) *The structure of applied general equilibrium models*. Cambridge MA: MIT Press.

Govindan, S. and R. Wilson (2001) 'Direct proofs of generic finiteness of Nash equilibrium outcomes', *Econometrica*, 69: 765-769.

Grogger, J. (1997) 'Market wages and youth crime', NBER working paper 5983, Cambrigde, MA.

Grossman, G., and E. Helpman (1994) 'Protection for sale', *American Economic Review*, 84: 833-849.

Grossman, H.I. (2000) 'Predators, moral decay, and moral revival', *European Journal of Political Economy*, 16: 173-187.

Grossman, H.I., M. Kim (1995) 'Swords or ploughshares? A theory of security claims to property', *Journal of Political Economy*, 103: 1275-1288.

Hellman, J.S., G. Jones, and D. Kaufmann (2000) 'Seize the state, seize the day: state capture, corruption and influence in transition'. Policy research working paper 2444.Washington: World Bank Institute.

Hobbes, Th. (1995) *Leviathan*, first edition: 1651. Meppel: Boom.

Hurley, J. (2000) 'An overview of the normative economics of the health sector,' Chapter 2 in H*andbook of Health Economics,* Vol. 1A, A.J. Culyer and J.P. Newhouse, eds. Amsterdam: North Holland.

Imrohoglu, A., A. Merlo, and P. Rupert (2000) 'On the political economy of income redistribution and crime', *International Economic Review*, 41:1-24.

Ilahi, N. and S. Jafarey (1999) 'Guestworker migration, remittances and the extended family: evidence from Pakistan'. *Journal of Development Economics* 58, 485-512.

Kaufmann, D., A. Kraay, and P. Zoido-Lobaton (1999) *Aggregating Governance indicators*. Policy research working paper 2195. Washington: World Bank Institute.

Keyzer, M.A. (1995) ‘Social security in a general equilibrium model with migration’, in N.S.S. Narayana and A. Sen, eds., *Poverty, environment and economic development.* Bangalore: Interline Publishers.

Kohlberg, E. and J.F. Mertens (1986) On strategic stability of equilibria. *Econometrica*, 54: 1003 -1037.

Lui, F.(1985) ‘An Equilibrium Queuing Model of Bribery’, *Journal of Political Economy*, 92: 760-81.

Negishi T. (1960) ‘Welfare economics and existence of equilibrium for a competitive Economy’, *Metroeconomica* 12:92-97.

Polinsky, A.M. and Shavell, S. (2000) ‘The economic theory of public enforcement of law’, *Journal of Economic Literature*, 38: 45-76.

Raphael, S, and R. Winter-Ebner (2001) ‘Identifying the effect of income on crime’, *Journal of Law and Economics*, 44:259-283.

Srinivasan, T.N. (1994) ‘Destitution: A discourse’, *Journal of Economic Literature*, 32: 1842-1855.World Bank (2000) *The Quality of Growth*. Washington, D.C: World Bank.

Zweifel, P., and F. Breyer (1997) *Health Economics.* Oxford: Oxford University Press.

The Centre for World Food Studies (Dutch acronym SOW-VU) is a research institute related to the Department of Economics and Econometrics of the Vrije Universiteit Amsterdam. It was established in 1977 and engages in quantitative analyses to support national and international policy formulation in the areas of food, agriculture and development cooperation.

SOW-VU's research is directed towards the theoretical and empirical assessment of the mechanisms which determine food production, food consumption and nutritional status. Its main activities concern the design and application of regional and national models which put special emphasis on the food and agricultural sector. An analysis of the behaviour and options of socio-economic groups, including their response to price and investment policies and to externally induced changes, can contribute to the evaluation of alternative development strategies.

SOW-VU emphasizes the need to collaborate with local researchers and policy makers and to increase their planning capacity.

SOW-VU's research record consists of a series of staff working papers (for mainly internal use), research memoranda (refereed) and research reports (refereed, prepared through team work).

Centre for World Food Studies
SOW-VU
De Boelelaan 1105
1081 HV Amsterdam
The Netherlands

Telephone (31) 20 - 44 49321
Telefax (31) 20 - 44 49325
Email pm@sow.econ.vu.nl
www http://www.sow.econ.vu.nl/