Inequality, Crime and Private Protection*

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Abstract

There is a consensus that inequality increases the supply of crime. As disparity in income grows within a society, the incentives for low-income individuals to engage in criminal activities also increase. However, in a context of high inequality, better-off individuals invest in deterring those who want to appropriate their resources. We examine this twofold effect of inequality in an equilibrium model of crime and private protection. We show that inequality unambiguously increases investment in private protection, but the relationship between inequality and crime is ambiguous, depending on how protection responds to private investment.

KEYWORDS. Inequality, Crime, Private Protection

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1 Introduction

Since the development of the economics of crime model by Becker (1968), the relationship between inequality and crime has received considerable attention in the theoretical literature. The standard argument adopted by this literature is that illegal behavior depends positively on the potential gains from crime and, negatively, on the associated opportunity cost (Ehrlich, 1973). As most offenders are from the lower part of the income distribution and most victims are from the upper part, higher inequality increases the incentives for criminal activity.

Following the early contributions, the subsequent studies on the income inequality-crime relationship almost unanimously confirmed their positive associations (Chiu and Madden, 1998; Bourguignon et al., 2003). Despite having a consensus from a theoretical point of view, the empirical evidence presents mixed findings. While several studies found a positive relation (Fajnzylber et al., 2002; Choe, 2008), some others demonstrated that inequality has a negative, or no effect, on property crime (Kelly, 2000; Neumayer, 2005; Brush, 2007).

In this paper, we argue that inequality not only increases the incentives for engaging in crime, but it also raises incentives for protection in the potential victims. Private crime protection is increasingly important in modern societies, and private security guards now overcome public officers in many countries. More importantly, private security correlates positively with inequality, as Figure 1 shows. In this sense, the incentives of inequality over crime are twofold, changing the equilibrium decisions for both perpetrators and victims.

[Figure 1 ABOUT HERE]

We develop a simple equilibrium model whereby the decision to engage in criminal activities determines the supply of crime, and the investment in private protection determines the demand for crime.[1] An increase in income inequality leads to a rightward shift in the supply of crime (the standard rational choice argument) but a simultaneous leftward shift in the demand. The net effect on the equilibrium crime levels is thus ambiguous, depending on the elasticity of both curves for changes in inequality. This, in turn, depends on how protection responds to private investment. The effect of inequality on private protection, on the contrary, is unambiguously positive.

[1] To our knowledge, few studies model demand, and supply in this way. See, for example, Vásquez (2021).

2 The Model

The society is populated by a continuum of measure one of agents divided into two groups: poor (P) and rich (R). The poor have income equal to y_P and the rich to y_R, with $y_P < y_R$. Let $\rho \in (0,1)$ denote the fraction of the rich and $(1-\rho)$ the fraction of the poor.

The agents make decisions related to crime. First, individuals decide whether to engage in criminal activities or not.[2] Crime is a choice under uncertainty, in which an individual can maintain his initial income endowment with certainty or engage in risky illegal activities. The criminal attacks one and only one other member of the society, henceforth called the victim, whose income is y'. When a crime is successful, the perpetrator appropriates a fraction $0 < \gamma < 1$ of the victim's income; when it fails, he receives an exogenous fine f, which we assume proportional to its initial income. Accordingly, the payment of criminals is:

$$y = \begin{cases} y + \gamma y' & \text{, if crime succeeds} \\ y(1-f) & \text{, if crime fails} \end{cases}$$

Individuals also decide how much to invest in private protection against crime. Each member of the society has a probability p of being assaulted, which depends on the fraction of criminals in the population.

Crime can be partially prevented. Let q denotes deterrence, or the probability that a criminal is apprehended, and the assault fails. We assume deterrence to be bounded because even if someone does not invest in private security, there is public police to protect him. On the other hand, investment in private security reduces crime, but it cannot eliminate it completely.

Individuals invest π to increase their protection (for instance, putting cameras and alarms in their homes or hiring a private security firm). The probability of deterrence is increasing in π according to the following protection technology $q(\pi)$:

$$q(\pi) = q_0 + q_1(\pi)$$

with $q_1(\pi)$ an increasing, concave and bounded C^1 function, with $q_1(0) = 0$, $q_1' > 0$, $q_1'' < 0$, and Inada condition at zero $q_1'(0) = \infty$. Accordingly, $q(\pi)$ is also increasing, concave and bounded within $(q_0, q_0 + q_1(\infty))$.

The utility of the individuals is logarithmic in income. The expected utility for an

[2] We assume that the decision to engage in crime is binary. Other frameworks assume that agents may divide their time into legal and illegal activities, as in Ehrlich (1973).

individual of income y and protection investment π, given a rate of crime p is:

$$U(y,\pi) = [(1-p) + pq(\pi)]log(y-\pi) + [p(1-q(\pi))]log((1-\gamma)(y-\pi)) \tag{1}$$

Finally, we assume that each individual has a moral cost c drawn from a distribution $H(\cdot)$.[3] Let $W_0(y,\pi)$ denote the utility of an agent who does not engage in crime, and $W_1(y,\pi,y',\pi')$ the utility of criminals, which also depends on the victim's income y' and level of protection π'. These utilities take the following form:

$$W_0(y,\pi) = U(y,\pi) \tag{2a}$$

$$W_1(y,\pi,y',\pi') = (1-q')U(y+\gamma(y'-\pi'),\pi) + q'U(y(1-f),\pi) - c \tag{2b}$$

with q' the deterrence level decided by the potential victim, that is, $q' = q(\pi')$.

The individuals' decisions are as follows. If they engage in crime, they decide whom to assault. Let y'' and π'' denote the income and protection of the optimal victim. They engage in crime if $W_0(y,\pi_0) < W_1(y,\pi_1,y'',\pi'')$, with π_0 and π_1 are optimal solutions for protection investment. We assume that protection investment is the same for all the members of the group; that is, we rule out unilateral deviation.[4]

Lemma 1. There exists $\widetilde{q}_0$ and $\widetilde{q}_1$, with $0 < \widetilde{q}_0 < \widetilde{q}_1 < 1$, such that for any $q \in [\widetilde{q}_0, \widetilde{q}_1]$ we have that

(i) no rich individuals engage in crime; poor individuals engage in crime depending on their idiosyncratic moral cost, and

(ii) only rich individuals are assaulted; accordingly, only the rich invest in protection.

Proof. A rich individual decides not to engage in crime if $W_0(y_R,\pi_R) \geq W_1(y_R,\pi'_R,y_J,\pi_J)$ for both $J = \{P,R\}$. First we assume that that $(1)\pi_R = \pi'_R$, and (2) the moral cost is zero, that is, $c = 0$; then we relax these assumptions. The expression W_1 is decreasing in $q = q_J$. For $q = 0$, we have that $W_0 < W_1$ for any J, and for $q = 1$, we have that $W_0 > W_1$ for any J, given that utility increases in income. For continuity, it exist $\widetilde{q}_0$ such that for all $q > \widetilde{q}_0$ then $W_0 > W_1$ for any J, and rich prefer not to engage in crime. Now we consider that $\pi_R \neq \pi'_R$. Then we evaluate the relation of π'_R observing that $W_0(y_R,\pi_R) \geq W_0(y_R,\pi'_R)$. We assume that $W_0(y_R,\pi_R) < W_0(y_R+\gamma y_J,\pi'_R)$ and all the previous results hold. Also for the case of

[3]This cost is introduced to have interior solutions. See, for instance, Bourguignon et al. (2003).

[4]There might be incentives for unilateral deviations because private protection investments divert crime to unprotected targets (Amodio, 2019).

moral cost. We assume the same inequality, but $W_0(y_R, \pi_R) = W_0(y_R, \pi_R) + c_{max}$. Assuming that $W_0(y_R, \pi_R) + c_{max} < W_0(y_R + \gamma y_J, \pi'_R)$, the previous results hold.

For $q > \widetilde{q}_0$, only poor individuals engage in crime. They decide whether to attack a rich or a poor depending on their levels of protection. In the limit case, a poor agent decides not to invest in protection. We define $\widetilde{q}_1$ as the protection in which a poor individual is indifferent between assaulting a poor with protection $\widetilde{q}_0$ (no investment) or a rich with $\widetilde{q}_1$. This expression is given by $(1-\widetilde{q}_1)U(y_P + \gamma y_R, \pi) + \widetilde{q}_1 U(y_P(1-f), \pi) = (1-\widetilde{q}_0)U(y_P + \gamma y_P, \pi) + \widetilde{q}_0 U(y_P(1-f), \pi)$, and existence follows trivially from the linearity in q. It is also direct that $\widetilde{q}_0 < \widetilde{q}_1$. For any $q < \widetilde{q}_1$, the poor decide to attack only individuals from the rich group.

For $q > \widetilde{q}_0$, (i) in Lemma 1 holds; for $q < \widetilde{q}_1$, (ii) holds. This completes the proof.

We use the lemma to simplify our problem. As our deterrence function is bounded, that is $q \in (q_0, q_0 + q_1(\infty))$, we assume that $q_0 = \widetilde{q}_0$ and $q_1(\infty) = \widetilde{q}_1 - \widetilde{q}_0$. Under this assumption, the result of the lemma holds, and poor are perpetrators and rich are victims. While this identification represents only a fraction of actual crimes, we justify the assumption because it captures the basic mechanism to study inequality in the standard theory of crime.[5]

2.1 Demand, Supply and Equilibrium

The demand for crime is the increasing relation between the total crime rate in society C and the overall level of protection Π. The more the level of crime, the more the resources allocated to avoid it. As only the rich invest in protection, $\Pi = \rho\pi$, and thus we focus our analysis on π. The demand is the optimal solution of (1) for the rich individuals. The probability p of a rich agent being assaulted is the total rate of crime divided by the proportion of the rich in the society, which is $C\rho^{-1}$. We optimize and solve for C:

$$C_D(\pi) = \rho(log(1-\gamma)^{-1}(y_R - \pi)q_\pi(\pi))^{-1} \quad (3)$$

The demand of crime $C_D(\pi)$ is an increasing function of private investment in protection π, given that $q(\pi)$ is concave and thus $q_\pi(\pi)$, and also $(y_R - \pi)$, are decreasing in π.

The supply of crimes $C_S(\pi)$ is the fraction of poor with low moral costs. The decision

[5] Focusing on the victimization of the rich by the hands of the poor is a great simplification, but it appears to be empirically supported in some contexts. For example, Bourguignon et al. (2003) found that offenders belong to the left part of the income distribution; according to Gaviria and Pagés (2002), the typical victims of property crime in Latin America come from wealthy and middle-class households.

depends on the level of protection of victims, which belong to the rich group. The supply is:

$$C_S(\pi) = (1-\rho)H[W_1(y_P, 0, y_R, \pi) - W_0(y_P, 0)] \tag{4}$$

The supply of crimes $C_S(\pi)$ is a decreasing function of private investment in protection π, given that $W_1(y_P, 0, y_R, \pi)$ is decreasing in π.

An equilibrium (C^*, π^*) is a level of protection π^* in which supply and demand of crime are equal to C^*. That is, $C^* = C_S(\pi^*) = C_D(\pi^*)$. The following proposition shows the existence and uniqueness of this equilibrium.

Proposition 1. There exists a unique equilibrium (C^*, π^*).

Proof. On the supply side, function $C_S(\pi^*)$ is decreasing in π. On the demand side, the function $C_D(\pi)$ is strictly increasing. Inada conditions for $q_1(\pi)$ imply that $C_D(0) = 0$. As $q_1(\pi)$ is increasing and bounded C^1 function, we have that $C_D(\infty) = \infty$. The existence of equilibrium follows from continuity. As demand function is strictly increasing, the equilibrium is unique.

2.2 Inequality

To study the effects of inequality, we rely on the well-known *Principle of Transfers*, which states that inequality increases when a unit of income is transferred from a poorer to richer individual (Dalton, 1920). To adapt this definition to our context, we consider a composite transfer from an entire group to another, the simultaneous increase (decrease) of all the group members. As such, inequality increases if each poor individual transfers one dollar to the rich group, such that each rich individual receives $(1-\rho)/\rho$ dollars.

Definition 1. An infinitesimal increase of inequality, that we define as $i + \Delta i$, is a simultaneous regressive transfer from all poor to all rich individuals, such that the final incomes in each group are $y_P - \Delta i$ and $y_R + ((1-\rho)/\rho)\Delta i$, respectively. Accordingly, we define the inequality derivative as:

$$\frac{\partial}{\partial i} = -\left(\frac{\partial}{\partial y_p} - \frac{(1-\rho)}{\rho}\frac{\partial}{\partial y_R}\right) \tag{5}$$

We use this definition to compute the effect of inequality changes in the standard model of crime given by (4) with a fixed q. As H is strictly increasing, the sign of the change is given by the derivative of the utilities. It is easy to verify that the derivative in y_P (y_R) is negative (positive), implying that criminal activities increase with inequality. The following proposition study the effect of inequality on the equilibrium (C^*, π^*).

Proposition 2. Let us consider an equilibrium (C^*, π^*). A change $\Delta i > 0$ on inequality implies a new equilibrium $(C^* + \Delta C^*, \pi^* + \Delta \pi^*)$ such that:

(i) $\Delta \pi^* > 0$. That is, an increase in inequality implies an unambiguous increase in the protection investment at the equilibrium.

(ii) ΔC^* can be either positive or negative, depending on the value of q_π at equilibrium. Crime is increasing (decreasing) in inequality for high (low) values of $q_\pi(\pi^*)$.

Proof. The new equilibrium satisfies $C^* + \Delta C = C_S(\pi^* + \Delta\pi, i + \Delta i) = C_D(\pi^* + \Delta\pi, i + \Delta i)$. As all functions are continuous, we extend at first order this expression to establish linear relationships between the rate changes. For the change in π we have the following derivative:

$$\Delta \pi^* = -\left(\frac{C_{S,i} - C_{D,i}}{C_{S,\pi} - C_{D,\pi}}\right)\Delta i \tag{6}$$

The supply and demand for crime are decreasing and increasing, respectively, with respect for protection. That is $C_{S,\pi} < 0$ and $C_{D,\pi} > 0$. As we previously explained, we also have that $C_{S,i} > 0$ (the standard model of crime). Besides, it is direct from the definition to show that $C_{D,i} < 0$. From these relationships, we conclude that the effect of Δi is positive on $\Delta\pi^*$ which is the part (i) of the Proposition.

Regarding (ii), the derivative of crime is $\Delta C^* = C_{S,\pi}\Delta\pi + C_{S,i}\Delta i$. Plugging (6) in this relationship, we have:

$$\Delta C^* = \left(\frac{C_{S,\pi}C_{D,i} - C_{S,i}C_{D,\pi}}{C_{S,\pi} - C_{D,\pi}}\right)\Delta i \tag{7}$$

The expression $C_{S,\pi} - C_{D,\pi}$ is negative. However, the sign of the term in the numerator depends on the responsiveness of protection to private investment, as we will show in what it follows. We define $x_R = y_R - \pi$ and $F(y_P, x_R(y_R, \pi), q(\pi)) = (1-\rho)H[W_1(y_P, 0, y_R, \pi) - W_0(y_P, 0)]$ where the last expression is the crime supply. Also we use $\rho' = (1-\rho)/\rho$. Using these definitions, the derivatives of crime demand and supply with respect to inequality and protection are: $C_{D,i} = -(\rho' C_D)/x_R$, $C_{D,\pi} = C_D/x_R - C_D(q_{\pi\pi}/q_\pi)$ and $C_{S,i} = -F_{y_P} + \rho' F_{x_R}$ and $C_{S,\pi} = q_\pi F_q - F_{x_R}$. From here, the expression in the numerator of (7) is $(q_\pi F_q - F_{x_R})(-(\rho' C_D)/x_R) - (-F_{y_P} + \rho' F_{x_R})(C_D/x_R - C_D(q_{\pi\pi}/q_\pi))$. After some algebra, the sign of this expression depends on the sign of: $F_{y_P} + (\rho' F_{x_R} - F_{y_P})x_R(q_{\pi\pi}/q_\pi) - \rho' q_\pi F_q$. Since we have that $F_{y_P} < 0$, $F_{x_R} > 0$ and $F_q < 0$, the first three terms in the previous expression are negative, and only the last one is positive. Consequently, the sign of (7) is positive if q_π is sufficiently high. Given that the denominator is negative, we conclude that more inequality reduce crime at equilibrium for low values of q_π. This is consistent with the insight that the demand for crime is more inelastic for low values of q_π because the results of protection are less responsive to the level of investment.

□

The Figure 2 illustrates the Proposition 2. As in the standard supply and demand curve model, the price - which is the protection purchased to avoid crime - is in the vertical axis. The continuous lines are the initial supply and demand curves, which cut at the original equilibrium. An increase in inequality shifts the two curves upward, and the dashed lines show the new equilibrium.

[Figure 2 ABOUT HERE]

The increase in inequality leads to an increase in the supply curve because, for a given level of deterrence, the economic incentives for crime are higher. At the same time, the demand curve also moves upwards with inequality in figure 2, because for the same level of crime, incentives for protection are higher. This leads to an unambiguous increase in the level of deterrence at equilibrium because victims react to the increase in crime by protecting themselves more. However, the effect of inequality on criminal activities in the new equilibrium depends on the particular elasticities of the equilibrium point. In particular, more inequality increases crime at equilibrium for high values of q_π, that is, when protection is more responsive to private investment.

3 Conclusions

In this work, we developed a simple theoretical model to make sense of the ambiguity found in the empirical literature on the income inequality-crime relationship. We show that inequality affects the supply of offenses but, simultaneously, the private demand for protection. The net crime effect is thus ambiguous and depends on the relative elasticity of both curves. Our model also shows how an increase in income inequality unambiguously leads to higher investment in private protection.

These results have some relevant implications. They call for a deeper theoretical understanding of the role of inequality in affecting crime. From an empirical point of view, our model suggests including personal security as a mediating factor in the regressions of crime on inequality. Finally, our work shows how private protection is a direct consequence of unequal societies.

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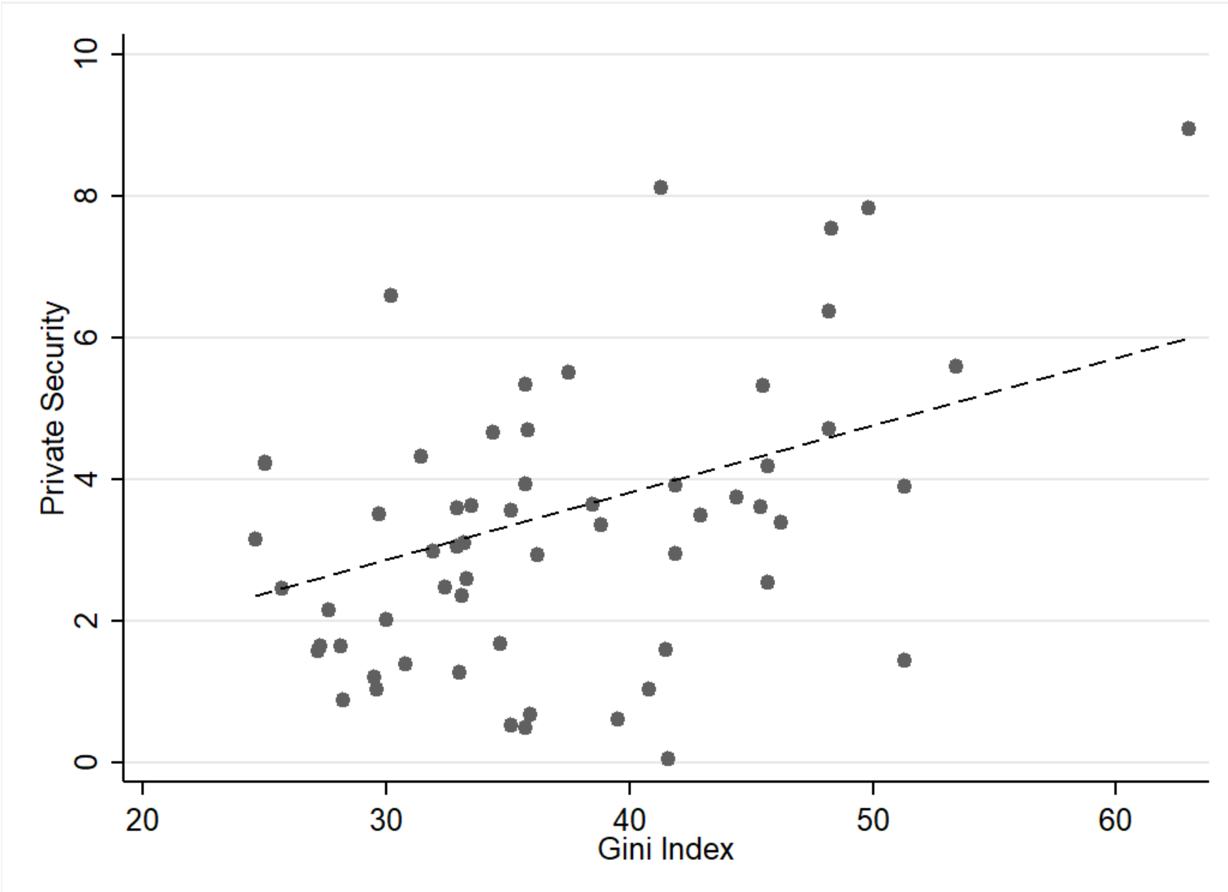
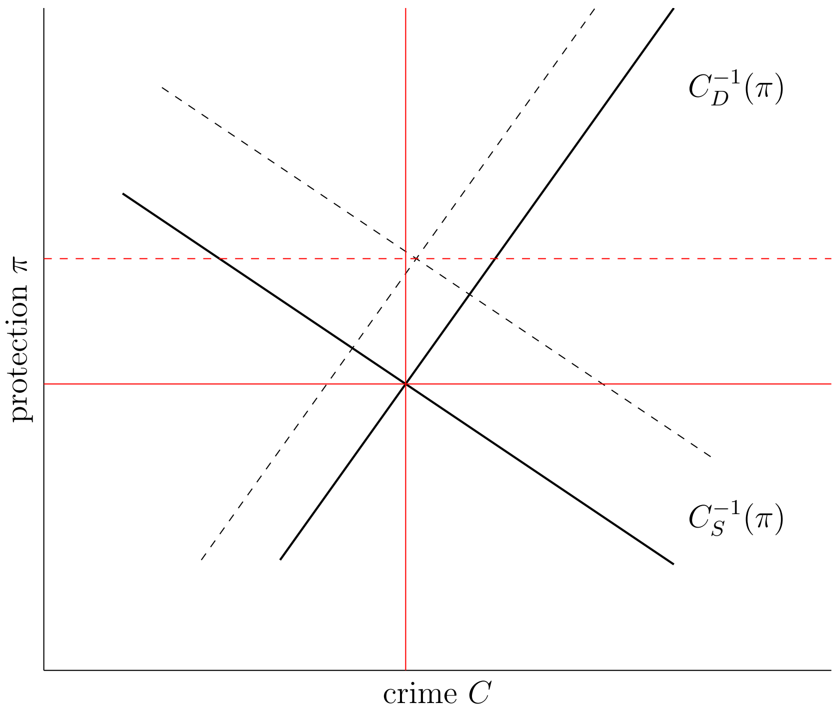
Figure 1: Private Security and Inequality



Data for 60 countries with population above two million. Sources: The Guardian, The Small Arms Survey, CoeSS and World Bank.

Figure 2: Supply and Demand for Crime



Supply and demand curves for crime and protection before (solid) and after (dash) an increase in inequality.