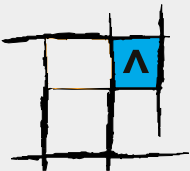




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Income Inequality and Crime Protection



# Income Inequality and Crime Protection

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## Abstract

This paper analyses the relationship between income inequality and expenditures on private and public protection when agents vote over the level of public spending while liquidity constraints prevent some of them from buying private protection. The income distribution, the public decision mechanism about spending on crime protection and the efficiency of private and public protection technologies will determine the pattern of crime victimization. We also examine the relationship between public and private crime protection and police corruption and show that under specific conditions access to private protection may lead indirectly to public police corruption and consequently to higher crime victimization inequalities.

## 1 Introduction

Until recently, economics of crime has relatively neglected the fact that private expenditures on crime protection stand at very close levels to total expenditures on the criminal justice system. For instance, in the United States, the few existing estimations of total private spending on crime protection oscillate between \$69 billion dollars (Anderson, 1999) and 300 billion dollars (Philipson and Posner, 1996), while Ayres and Levitt (1998) estimates that total government spending on criminal justice in 1995 was almost \$100 billion

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dollars. Moreover, expenditures on private protection appear to be growing at a rate faster than public spending. In the United States, Sherman (1995) mentions that security guard industry grew by 11 percent in 1994 while local public police personnel numbers grew by only 5 percent from 1986 to 1992. In Brazil, Musumeci (1998) estimates that employment in security guard industry grew by 120 percent between 1985 and 1995, while the corresponding figure for public policy is only 44 percent !

However, most of the studies which focus on the demand for crime protection primarily examine the positive or negative externalities that private protection may provide. In other words, their main purpose is to evaluate to what extent private protection measures deter criminals or simply divert them towards other potential victims<sup>1</sup>. In contrast, little has been done to explain how demand for public and private crime protection is determined. Clotfelter (1977) is one of the few exceptions. Similarly, while the effect of income inequality on crime has been carefully analysed<sup>2</sup>, its counterpart, ie the effect of income inequality on the demand for public and crime protection, has been overlooked. In the present paper, we propose to examine how public and private crime protection are jointly determined in the presence of income inequality. In fact, the principal purpose of our paper is to analyse how income inequality affects the pattern of crime victimization through its effects on public and private protection spending. To our knowledge, Levitt (1999), Gaviria and Pages (1999) are among the few papers which examine, from an empirical point of view, how crime victimization is distributed across the poor and the rich, while our paper is the first to tackle this question theoretically.

The structure of the model is very simple. Potential victims can affect the probability of becoming victims and the extent of their loss if victimized by buying protection devices (locks, burglar alarm systems) or paying higher rents for living in safe neighborhoods or hiring private guards. However, in the absence of perfect capital markets those individuals whose post-tax

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<sup>1</sup>Theoretical studies on the externalities associated with private protection include, among others, De Meza and Gould (1992), Hui-Wen and Png (1994) and Ben-Shahar and Harel (1995). See Ayres and Levitt (1998) for an empirical analysis of the externalities induced by private protection efforts.

<sup>2</sup>See for example Bourguignon (1999), Chiu and Madden (1998), Grossman and Min-seong (1996) for a theoretical approach and Fajnzylber, Lederman, and Loayza (1999) and Soares (2000) for empirical results.

income is below the minimum cost required for investing in private protection will be unable to do so. In contrast, all agents will benefit from public protection. Determination of public protection spending is based on a simple political economy mechanism through which a pivotal voter in the economy decides on the value of the tax rate used to finance public police. Public and private spending determines in turn the probability of crime victimization. Finally, when victimized, an agent incurs a crime cost. For simplicity, the crime cost, related to the illegal income, is assumed exogenous. Thus, in our model, the crime rate indirectly affects public and private protection spending through the crime cost.

The main result of the paper is that crime victimization inequality is increasing in the income of the pivotal voter who sets the level of public protection expenditures. To be more precise, we find that, when the pivotal voter is an agent who can invest in private protection, he will set public protection spending at a level inferior to the level which would have been set by a pivotal voter unable to invest in private protection. This helps to explain why crime victimization is generally disproportionately concentrated on the poor<sup>3</sup>. Assuming that the tax rate used to finance public protection spending is set by a rich agent, who can invest in private protection, it becomes clear that the poor, who can not invest in private protection, will suffer from an underprovision of crime protection. In contrast, other agents will compensate low public protection spending by investing more in private protection. Furthermore, we show that public police corruption may accentuate crime victimization inequality. Noting that under particular assumptions public police corruption is only the consequence of the fact that some agents can buy private protection, it suggests that income inequality may exacerbate crime victimization inequality in two ways, directly because of the unequal access to private protection and indirectly through the appearance of public police corruption.

The rest of the paper is organized as follows. In section 2, we describe and resolve the basic model. Section 3 derives some comparative statics results. In section 4, we introduce police corruption and examine its effect on crime victimization. Finally, section 5 gives some concluding remarks. In particular, we analyse the possible implications of our results on the pattern

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<sup>3</sup>For example, Levitt (1999) finds that, in the United States, property crime victimization becomes increasingly concentrated on the poor over time. As an illustration, by the 1990s, the poor households were 60 percent more likely to be victims of burglary.

of property and violent crime victimization in some illustrative countries.

## 2 The model

### 2.1 The basic framework

Consider an economy with population scaled to unity and divided into two classes of agents, the poor and the rich. A proportion  $p$  of agents are poor while the remaining  $1 - p$  are rich. Throughout the paper superscript  $p$  denotes poor agent and  $r$  denotes rich agent. Let  $w^i$  be the initial earnings of an agent belonging to the class  $i = p$  or  $r$ . Pre-tax incomes are characterized by the following inequality:  $w^r > w^p$ . We note  $\bar{w}$  the mean income of the population:  $\bar{w} = pw^p + (1 - p)w^r$ . All agents are assumed to be risk neutral.

Post-tax income is given by:  $\hat{w}^i = (1 - \tau)w^i - e^i$ , for  $i = p$  or  $r$ , where  $\tau \in [0, 1]$  is the tax rate on income used to finance public police and  $e^i$  is the level of private protection expenditures decided by each agent belonging to class  $i$ . The median voter sets the tax rate. We will consider alternatively a poor and a rich agent as pivotal voter. Underscript  $j = p$  or  $r$  indicates that the pivotal voter belongs to the class  $j$ .

Each agent is faced with a probability of being victimized by a criminal. With probability  $q_s$ , public police are successful to apprehend criminals or dissuade potential criminals. With probability  $q_m^i$ , private protection measures taken by an agent of type  $i$  are effective to protect him from crime. Therefore, the probability of being victimized is equal to  $(1 - q_s)(1 - q_m^i)$  for agent belonging to class  $i$ <sup>4</sup>. Following Imrohorglu and Merlo (1996), we assume that public and private protection technologies are given by:

$$\begin{aligned} q_s &= 1 - (\tau\bar{w})^{-\theta_s} \text{ for } \tau\bar{w} > 1 \\ q_s &= 0 \text{ for } \tau\bar{w} \leq 1 \end{aligned} \tag{1}$$

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<sup>4</sup>In fact, everything else being equal, a rich is more likely to be victim of a property crime than a poor, because his wealth transforms him into a more attractive target for the criminal than the poor. As a consequence, the probability of victimization that we used for simplicity in our model is slightly different from what would have been a “true” probability of victimization.

$$\begin{aligned}
q_m^i &= 1 - (e^i)^{-\theta_m} \text{ for } e_t^i \geq \tilde{e} \\
q_m^i &= 0 \text{ for } e^i < \tilde{e}
\end{aligned} \tag{2}$$

where  $\theta_s \in (0, 1)$  and  $\theta_m \in (0, 1)$  are parameters that measure respectively the efficiency of public and private anticrime expenditures and  $\tilde{e} > 1$  a fixed cost to private protection measures. We assume that  $\bar{w}$  is defined such that  $\tau\bar{w} > 1$  is verified whatever  $\tau \in ]0, 1]$ . Thus, the probability of being victimized is decreasing and convex in the level of private or public expenditures.

There is no capital market where agents who can not cover the fixed cost of private security can borrow. We assume that the poor do not invest in private security because they are liquidity-constrained whereas the rich are not:

$$w^p < \tilde{e} < w^r \tag{3}$$

Therefore, we always have:  $e^p = 0$ ,  $q_m^p = 0$  and  $e^r \in \{0\} \cap [\tilde{e}, (1 - \tau)w^r]$ .

An agent if victimized faces a crime cost,  $v$ . For simplicity we consider that the crime cost is independent of the wealth of the agent. We assume that the crime cost is positively related to the average illegal income:  $v = \lambda w_c$  where  $w_c$  is the average illegal income and  $\lambda > 0$  measures the extent to which crime impacts on victim wealth<sup>5</sup>.

Overall utility of an agent belonging to class  $i$  is:

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<sup>5</sup>Crime costs can be divided into two categories: explicit pecuniary lost due to property crime (theft, car theft, burglary...) and implicit crime cost due to violence, in other words, health losses (injuries, pain, suffering, mental distress...). The crime cost due to violence may be the by-product of property crime or related to the existence of illegal markets. In the case of property crime, criminals can use violence when stealing has been unsuccessful without it. In the context of illegal markets, it has been shown that violence is used as a mechanism of dispute resolution between participants and that the degree of violence is positively related to illegal resources at stake (See Levitt and Donohue III (1998) for a theoretical approach and Miron (1999, 2000) for some empirical results). Loosed by participants to illegal markets, violence may also affect non-participants, when it leads to the hiring or death of innocent by-standers caught in some cross-fire.

$$U^i = [q_s + (1 - q_s) q_m^i] [(1 - \tau) w^i - e^i] + (1 - q_s) (1 - q_m^i) [(1 - \tau) w^i - e^i - v] \quad (4)$$

## 2.2 The anticrime expenditures decisions

Therefore the maximization program of a poor agent is given by:

$$\max_{\tau \in [0,1]} U^p = (1 - \tau) w^p - (1 - q_s) v \quad (5)$$

The maximization program of a rich agent is slightly different whether the pivotal voter is a rich or a poor agent. If the pivotal voter is a rich agent, a rich agent makes its decision according to the following program:

$$\begin{aligned} \max_{\tau, e^r} U^r &= ((1 - \tau) w^r - e^r) - (1 - q_s) (1 - q_m^r) v & (6) \\ \text{st } \tau &\in [0, 1] \text{ and } e^r \in [\tilde{e}, (1 - \tau) w^r] \cap \{0\} \end{aligned}$$

If the pivotal voter is a poor agent, it becomes:

$$\begin{aligned} \max_{e^r} U^r &= (1 - \tau_p) w^r - e^r - (1 - q_s(\tau_p)) (1 - q_m^r) v & (7) \\ \text{st } e^r &\in [\tilde{e}, (1 - \tau_p) w^r] \cap \{0\} \end{aligned}$$

Then, we can deduce the two following propositions. Proposition 1 directly results from the resolution of (5), while proposition 2 comes from the resolution of (6) and (7).

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Therefore, we could have written  $v$  as  $v^i = \lambda' w_c' + (1 + \lambda'') \widehat{w}^i$  where  $\lambda', \lambda'' \geq 0$ .  $\lambda'$  measures the effect of violence when it is related to illegal markets while  $w_c'$  is the average income derived from participation to illegal markets. Clearly  $\lambda''$  is the violence cost parameter when violence is the by-product of property crime while  $\widehat{w}^i$  is the direct lost from property crime. With that structural form, the crime cost becomes dependant of the victim wealth (at least through the effect of property crime, but it might be that the effect of violent crime differs with human capital, that is:  $\lambda = \lambda(w^i)$ ).

**Proposition 1**

When the pivotal voter is a rich agent, who can invest in private protection, it can be shown that:

- for  $w^r > \left(1 + \frac{\theta_s}{\theta_m}\right) \tilde{e}$  :

if  $v > \Omega_1$ , then:

$$\tau_r = \frac{\theta_s}{\theta_s + \theta_m} \quad ; \quad e_r^r = \frac{\theta_m}{\theta_s + \theta_m} w^r \quad (8)$$

if  $\Omega_1 > v > \Omega_2$ , then:

$$\tau_r = \left[ \phi_{ms} \frac{v}{\left(\frac{\bar{w}}{w^r}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s+\theta_m}} \frac{1}{w^r} \quad ; \quad e_r^r = \left[ \phi_{sm} \frac{v}{\left(\frac{\bar{w}}{w^r}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s+\theta_m}} \quad (9)$$

if  $\Omega_2 > v$ , then:

$$\tau_r = \left[ \theta_s \frac{1}{(\tilde{e})^{\theta_m}} \frac{v}{\left(\frac{\bar{w}}{w^r}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s}} \frac{1}{w^r} \quad ; \quad e_r^r = \tilde{e} \quad (10)$$

- for  $w^r < \left(1 + \frac{\theta_s}{\theta_m}\right) \tilde{e}$  :

if  $v > \Omega_3$ , then:

$$\tau_r = 1 - \frac{\tilde{e}}{w^r} \quad ; \quad e_r^r = \tilde{e} \quad (11)$$

if  $v < \Omega_3$ , then:

$$\tau_r = \left[ \theta_s \frac{1}{(\tilde{e})^{\theta_m}} \frac{v}{\left(\frac{\bar{w}}{w^r}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s}} \frac{1}{w^r} \quad ; \quad e_r^r = \tilde{e} \quad (12)$$

where  $\Omega_1$ ,  $\Omega_2$  and  $\Omega_3$  are defined respectively by:

$$\Omega_1 = \frac{1}{\phi_{sm}} \left(\frac{\bar{w}}{w^r}\right)^{\theta_s} \left(\frac{w^r}{1+\frac{\theta_s}{\theta_m}}\right)^{1+\theta_s+\theta_m}$$

$$\Omega_2 = \frac{1}{\phi_{sm}} \left(\frac{\bar{w}}{w^r}\right)^{\theta_s} \tilde{e}^{1+\theta_s+\theta_m}$$

$$\Omega_3 = \frac{1}{\theta_s} \left(\frac{\bar{w}}{w^r}\right)^{\theta_s} (\tilde{e})^{1+\theta_s+\theta_m} \left(\frac{w^r}{\tilde{e}} - 1\right)^{1+\theta_s}$$

and where  $\phi_{ij}(\theta)$  is defined by  $\phi_{ij}(\theta) = \theta_j \left(\frac{\theta_j}{\theta_i}\right)^{\theta_i}$  for  $i, j = s, m$ .

Interestingly, when  $w^r > \left(1 + \frac{\theta_s}{\theta_m}\right) \tilde{e}$ , we can note that for crime costs sufficiently large, ie  $v > \Omega_2$ , we have:  $\frac{\tau_r w^r}{\theta_s} = \frac{e_r^r}{\theta_m}$  while for  $v \leq \Omega_2$ , we have:  $\frac{\tau_r w^r}{\theta_s} < \frac{e_r^r}{\theta_m}$ . In words, when the crime cost is relatively high, a rich agent will always equalize its public and private spending by efficiency unit. Unsurprisingly, in that case, when private protection efficiency is superior (inferior) to public protection efficiency, a rich agent will always spend more (less) in private protection than in public protection. However, when the crime cost is relatively low, a rich agent will always spend more by efficiency unit in private protection than in public protection. As private spending remains superior to public spending when the private protection efficiency is superior to the public protection efficiency, the opposite is no longer necessarily verified in the case of a low crime cost. The fact that an agent which is able to invest in private protection has always interest in doing so and that any investment in private protection must cover a fixed cost  $\tilde{e}$  explains why, in some cases, a rich agent will spend more in private protection than in public protection even if the public protection efficiency is the higher.

## Proposition 2

1. When the pivotal voter is a poor agent, who can not invest in private protection, it can be shown that:

- for  $v > \frac{1}{\theta_s} (\bar{w})^{\theta_s} w^p$ :

$$\tau_p = 1$$

- for  $v < \frac{1}{\theta_s} (\bar{w})^{\theta_s} w^p$  :

$$\tau_p = \left[ \theta_s \frac{v}{\left(\frac{\bar{w}}{w^p}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s}} \frac{1}{w^p} \quad (13)$$

2. Then we can deduce the level of private crime prevention expenditures decided by the rich:

- for  $w^r > \frac{\tilde{e}}{1 - \frac{\theta_s}{\theta_m} \tilde{e}^{\theta_m}}$  and  $w^p > \left(\frac{\theta_s}{\theta_m}\right) \frac{\tilde{e}^{1+\theta_m}}{1 - \frac{\tilde{e}}{w^r}}$ , we find that:

if  $\Gamma_1 > v > \Gamma_2$ , then:

$$e_p^r = w^r - \left[ \theta_s \frac{v}{\left(\frac{\bar{w}}{w^p}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s}} \frac{w^r}{w^p} \quad (14)$$

if  $\Gamma_2 > v > \Gamma_3$ , then:

$$e_p^r = \left[ \phi_{sm} \frac{v}{\left(\frac{\bar{w}}{w^p}\right)^{\theta_s}} \right]^{\frac{1}{(1+\theta_m)(1+\theta_s)}} \quad (15)$$

if  $\Gamma_3 > v$ , then:

$$e_p^r = \tilde{e}$$

where  $\Gamma_1$ ,  $\Gamma_2$  and  $\Gamma_3$  are defined by:

$$\begin{aligned} \Gamma_1 &= \frac{1}{\theta_s} \left(1 - \frac{\tilde{e}}{w^r}\right)^{1+\theta_s} (\bar{w})^{\theta_s} w^p \\ \left[ \phi_{sm} \frac{\Gamma_2}{\left(\frac{\bar{w}}{w^p}\right)^{\theta_s}} \right]^{\frac{1}{(1+\theta_m)(1+\theta_s)}} \frac{1}{w^r} + \left[ \theta_s \frac{\Gamma_2}{\left(\frac{\bar{w}}{w^s}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s}} \frac{1}{w^p} &= 1 \\ \Gamma_3 &= \frac{1}{\phi_{sm}} \left(\frac{\bar{w}}{w^p}\right)^{\theta_s} (\tilde{e})^{(1+\theta_s)(1+\theta_m)} \end{aligned}$$

- for  $w^r < \frac{\tilde{e}}{1 - \frac{\theta_s}{\theta_m} \tilde{e}^{\theta_m}}$  but  $w^p > \left(\frac{\theta_s}{\theta_m}\right) \tilde{e}^{1+\theta_m}$  and  $\left(\frac{\theta_s}{\theta_m}\right) \tilde{e}^{\theta_m} < 1$ , it can be shown that:

if  $v < \Gamma_3$ , then:

$$e_p^r = \tilde{e}$$

- for any other values of the parameters, we find that:

$$e_p^r = 0$$

We define probabilities of crime victimization for the poor and the rich respectively as  $P_j^p = (\tau_j \bar{w})^{-\theta_s}$ ,  $P_j^r = (e_j^r)^{-\theta_m} (\tau_j \bar{w})^{-\theta_s}$  when  $e_j^r \geq \tilde{e}$  and  $P_j^r = P_j^p$  when  $e_j^r = 0$ , for  $j = p, r$ .

### Proposition 3

*From the two preceding propositions, we deduce the following results:*

- *If the pivotal voter is a poor agent and the crime cost is relatively large, then the rich and the poor exhibit the same likelihood of being victimized:*

$$P_p^r = P_p^p$$

*Otherwise, due to their access to private protection, the rich are less likely to be victimized than the poor:*

$$P_j^r < P_j^p \quad \text{for } j = p, r$$

- *The poor are always more likely to be victimized when the pivotal voter is a rich agent than when he is a poor agent:*

$$P_p^p < P_r^p$$

*The equivalent proposition applied to the rich is not necessarily true : the rich are not always more likely to be victimized when the pivotal voter is a poor agent than when he is a rich agent.*

Proof:

The first part of the proposition comes from a direct observation of Proposition 1 and 2. Proposition 1 indicates that  $e_r^r > 0$ , whatever the value of the parameters. Furthermore, under specific conditions, ie  $v > \frac{1}{\theta_s} \left(1 - \frac{\tilde{e}}{w^r}\right)^{1+\theta_s} (\bar{w})^{\theta_s} w^p$ , Proposition 2 indicates that  $e_p^r = 0$ . The second part of the proposition follows from a simple comparison between the tax rate decided by a poor pivotal voter and the tax rate decided by a rich pivotal voter, for identical conditions on the parameters. Indeed, after simple calculations, we find that:  $\tau_r < \tau_p$  for all possible values of the parameters.

The first part of the proposition simply states that when the poor set the level of public anticrime expenditures and face a high crime cost, they extend their liquidity constraints to the rich. The poor impede the rich to invest in private protection by imposing on them a high tax rate to finance the level of public police expenditures required by the high victimization cost. Consequently, no agent invests in private protection. The poor and the rich face the same probability of crime victimization.

The second part of the proposition tells us unsurprisingly that the poor are less likely to be victimized when they decide themselves the level of public anticrime expenditures. Clearly, as the rich have access to private protection, they always prefer to divert some part of their income from public to private protection. As a consequence, the level of public anticrime expenditures decided by the rich is always inferior to the level that the poor would have been decided under the same conditions. In other words, when the rich set the level of public anticrime expenditures, there is always underprovision of public protection for the poor. Obviously, we have the opposite when the poor set the level of public protection spending: there is overprovision of public protection for the rich. However, it remains unclear whether there is underprovision of private protection, as it would be expected (it is for example the case when we restrict the analysis to interior solutions), or not. In any case, total crime protection may be overprovided or underprovided for the rich when the poor set the level of public protection spending.

### 3 Comparative Statics

Restricting the analysis to interior solutions<sup>6</sup>, which present the most interesting, we deduce the following comparative statics results for the level of private and public expenditures:

#### Proposition 4

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<sup>6</sup>Remark that the higher  $w^r$ , the larger the interval of values  $v$  for which public and private protection spending levels are interior. Thus, in the case of a relatively large  $w^r$ , even if we limit the analysis to interior solutions, our results are valid for a large spectrum of values for the crime cost.

- *Public and private anticrime expenditures are increasing in the crime cost  $v$ , whatever the type of the pivotal voter.*

*Moreover, we have the two following relationships:*

$$\frac{\frac{\delta \tau_r w^r}{\delta v}}{\frac{\delta e_r^r}{\delta v}} = \frac{\theta_s}{\theta_m} \quad (16)$$

$$\frac{\xi_{\tau_p/v}}{\xi_{\tau_r/v}} = 1 + \frac{\theta_m}{1 + \theta_s} \quad (17)$$

- *Public (private) anticrime expenditures are increasing (decreasing) in the level of income inequality  $\frac{w^r}{w^p}$  when the pivotal voter is a poor agent. Public (private) anticrime expenditures are decreasing (increasing) in the level of income inequality  $\frac{w^r}{w^p}$  when the pivotal voter is a rich agent.*
- *Public and private anticrime expenditures can decrease or increase when  $\theta_m$  or  $\theta_s$  varies, whatever the type of the pivotal voter (with the exception of the public anticrime expenditures set by a poor agent, which are independent of  $\theta_m$  for obvious reasons).*

Proof: these comparative statics results are directly deduced from derivations of (9), (13) and (15) (See Proposition 1 and 2).

The results for the crime cost  $v$  are quite intuitiv. When the cost of crime increases, both private and public protection spending increase, whatever the type of the pivotal voter. But it is important to note that they increase in unequal proportions, depending of the efficiency ratio between public and private protection. First, when the public protection efficiency is superior (inferior) to the private protection efficiency, public spending by a rich agent will increase more (less) than its private spending as a response to the increase in the crime cost. Second, the poor will always react more to a crime cost increase than the rich when setting the public protection spending. Moreover, the reaction of the poor will be all the more strong relatively to the rich since the private (public) protection efficiency is high (low). This last result

directly comes from (16). When the private protection efficiency is the higher, the rich increase more private spending than public spending to respond to an increase in the crime cost and consequently the difference between public spending set by the poor and public spending set by the rich widens.

As a result, when the rich set the level of public spending but have a strong interest in investing in private protection because of a favourable efficiency ratio, a greater crime cost will be associated with larger inequalities between the poor and the rich with respect to crime victimization.

The second part of the proposition leads to a similar conclusion. When the rich set the level of public spending, larger income inequality will induce larger crime victimization inequality. Indeed, while public spending increases with income inequality when the pivotal voter is poor, it decreases when he is rich. In fact, a poor agent will take advantage of larger income inequality by increasing the tax rate used to finance police expenditures, in other words, by increasing the extent of redistribution which takes here the form of public protection expenditures. As a result, a rich agent will be constrained to substitute public protection to private protection. On the contrary, consecutively to a rise in income inequality, a rich chooses to substitute, to some extent, private protection to public protection spending.

Finally, an increase in the private or public protection efficiency has a priori ambiguous effects on the level of public and private protection spending. Indeed, any increase in protection efficiency induces a wealth effect and a substitution effect with opposite signs. It can be shown that, for some particular values of the parameters, public or private protection spending is increasing in both private and public protection efficiencies. It simply may reflect the fact that the wealth effect exceeds the substitution effect for one type of protection spending, while the opposite is true for the other type.

## 4 Income Inequality, Crime Protection and Police Corruption

We introduce public police corruption and examine its consequences on the levels of public and private protection spending. We note  $\eta$  the corruption rate of public police and  $w_u$  the reservation police income above which no police officer accepts to participate to active or passive corruption. We assume

that police corruption appears when the level of public protection expenditures is insufficient to cover the reservation police income  $w_u$ <sup>7</sup>. We note  $\tau^{nc}$  the tax rate used to finance public spending in absence of public police corruption and defined by Proposition 1 or 2. Then we can define the new probability of criminal apprehension or dissuasion by public police by<sup>8</sup>:

$$\begin{aligned} q'_s &= (1 - \eta) q_s & \text{for } \tau^{nc}\bar{w} < w_u \\ q'_s &= q_s & \text{for } \tau^{nc}\bar{w} \geq w_u \end{aligned} \quad (18)$$

where  $0 < \eta < 1$ .

The results of Proposition 1 and 2 are now slightly different. In particular, we can show that:

### Proposition 5

*For corresponding values of the parameters, the level of public protection spending is always higher without police corruption than with police corruption. In other words, the poor are always more likely to be victimized when there is police corruption than when there is not.*

Proof: When the pivotal agent is a poor agent, knowing that  $\tau_p^{nc}\bar{w} < w_u$ , it is easy to see that a poor agent will set the following tax rate:

$$\tau_p^c = \left[ \theta_s (1 - \eta) \frac{v}{\left(\frac{\bar{w}}{w^s}\right)^{\theta_s}} \right]^{\frac{1}{1+\theta_s}} \frac{1}{w^p} < \tau_p^{nc}.$$

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<sup>7</sup>Consider the number of police officers  $n$  scaled to unity. Then the legal income of a police officer is exactly  $\tau\bar{w}$ . We note  $w_u$  the expected illegal income net of moral costs, which results from passive (bribe taking) or active (participation to illegal markets) corruption. Adopting an approach “à la Becker”, we follow Becker and Stigler (1974) who claim that “the fundamental answer is to raise the salaries of enforcers above what they could get elsewhere” and assume that police corruption is wiped out when  $\tau\bar{w} \geq w_u$ .

<sup>8</sup>We can interpret this particular formalization of police corruption as follows: when there is police corruption, a proportion  $(1 - \eta)$  of the police officers remains honest and participates actively to the fight against crime while a proportion  $\eta$  of the police officers is corrupt and does not arrest criminals or even try to do so. As a result, the probability for the public police to apprehend or dissuade a criminal is now:  $(1 - \eta) q_s + \eta \cdot 0$

Similarly, when the pivotal voter is a rich agent, knowing that  $\tau_r^{nc}\bar{w} < w_u$ , it is easy to show that he will choose a tax rate inferior to the tax rate chosen in absence of public police corruption. For example, in the case of an interior solution for both the tax rate and private protection spending, the tax rate under public police corruption must satisfy:  $f(\tau_r^c) = 0$ , where

$$f(x) = (\theta_m \eta v) (x)^{\frac{(1+\theta_m)(1+\theta_s)}{\theta_m}} + \left( \theta_m (1 - \eta) \frac{v}{w^{\theta_s}} \right) x^{\frac{1+\theta_m+\theta_s}{\theta_m}} - \left( \theta_s (1 - \eta) \frac{v}{w^{\theta_s} w^r} \right)^{\frac{1+\theta_m}{\theta_m}}$$

$\tau_r^{nc} > \tau_r^c$  follows from the fact that  $f$  is increasing with  $x$  and  $f(\tau_r^{nc}) > 0$  where  $\tau_r^{nc}$  is defined by (9). All other cases are similar.

Clearly, police corruption acts as a “multiplicativ effect” on poor crime victimization and, as such, exacerbates crime victimization inequality, whatever the type of the pivotal voter. Moreover, assuming that  $\tau_p^{nc}\bar{w} \geq w_u > \tau_r^{nc}\bar{w}$ , we have an interesting configuration<sup>9</sup>: while a poor pivotal voter sets a level of public protection expenditures sufficient to prevent police corruption, it is not the case of a rich pivotal voter. Then, police corruption appears as a by-product of income inequality in the sense that it is the access to private protection, combined with a political power over public protection spending in hands of the rich, that gives place to public police corruption. Thus, in such a configuration, income inequality leads to police corruption and still larger crime victimization inequality in the case of a rich pivotal voter, which would not have been the case if the pivotal voter had been a poor agent.

## 5 Concluding Remarks

First, it may be interesting to develop a non-overlapping generations extension of the preceding model, adding the possibility of investment in physical or human capital for the poor and the rich (forthcoming). By considering an explicitly dynamic economy, we can analyse the degree of persistence of crime victimization inequality and, to a certain extent, of income inequality. Intuitively, when the pivotal voter is initially a rich agent, income inequality is likely to increase crime victimization inequality, as proved in the previous

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<sup>9</sup>According to Proposition 3, we always have  $\tau_p > \tau_r$  when there is no police corruption. Thus, such a configuration exists: we can find particular values of the parameters for which we have:  $\tau_p\bar{w} \geq w_u > \tau_r\bar{w}$

sections. Assuming that the return of investment in capital is decreasing in the probability of being victimized, higher crime victimization inequality will lead in turn to larger income inequalities in the next period. In that case, the dynamics will create a highly segregated society in terms of exposition to crime with the overprotected rich on one side and the overvictimized poor on the other. In contrast, when the pivotal voter is initially a poor agent, the dynamics may be exactly the opposite: initial income inequality reduces crime victimization inequality, making possible higher investment in physical or human capital. As a result, poverty decreases over time until the distribution of wealth in the economy leads to a pivotal voter sufficiently wealthy to invest in private protection.

Secondly, an important argument is absent of the victimization probability. Indeed, we do not consider the fact that the attractiveness of a victim for property crime perpetrators is a function of its wealth. As a consequence, the results would be slightly different for property crime. The stronger attractiveness of a rich agent may induce him to invest more in private protection than our results suggest. Further examination is clearly needed.

Thirdly, the few empirical results on the distribution of crime victimization across the poor and the rich suggest that the distribution of crime victimization is likely to vary with the crime category. Indeed, Levitt (1999) shows that property crime victimization inequality between the poor and the rich has significantly increased over the past two decades in the United States, property crime victimization becoming more concentrated on the poor at a time when income inequality was increasing too. In contrast, he finds that the murder gap between the rich and the poor was narrowing during the same period. The simple fact that the crime protection efficiency may be higher for property crime than for violent crime<sup>10</sup> may reconcile these results. Our model suggests a complementary explanation. It seems reasonable to assume that in the United States the pivotal voter who sets the level of public protection spending is an agent who invests in private protection devices. Thus, our model predicts that, as a response to the increase in income inequality, private protection spending will increase while public protection spending will decrease. It is important to note that public police and private protection measures have not the same function. As Sherman (p 339, 1995)

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<sup>10</sup>The unique way to protect oneself with a possibly high efficiency from violent crime may be residence in a gated community. See Helsley and Strange (1999) for an analysis of the demand for gated communities.

wrote, “the key difference between police and security guards is that police protect public places, not private property”. Clearly, private protection devices seem to be more efficient in protecting private property from crime than public police while the opposite seems true for safety in public place. It is not unreasonable to assume that violent crime is more likely to occur in a public place than in a private property. Consequently, an increase in property crime victimization inequality combined with a decrease in violent crime victimization inequality may follow the reallocation from public protection spending to private protection spending decided by the rich as a result of the income inequality increase.

However, the value of the preceding analysis for the United States considerably depends on the intensity of the illegal market activities and on the degree of spatial segregation between the poor and the rich<sup>11</sup>. In most cases, illegal markets activities are concentrated in the poorest neighborhoods. Thus, when there is a jointly high degree of violence related to illegal markets and of spatial segregation between the poor and the rich, any decrease in the expenditures of the justice criminal system, which has to fight against illegal market activities (in particular drugs trafficking), will lead to a disproportionate increase of violent crime victimization among the poor. In that respect, South Africa and Brazil seem to be exemplary for similar reasons. Both are characterized by high level of income inequality. Coherent with the predictions of our model, Musumeci (1998) for Brazil and Shaw (1998) for South Africa suggest that the criminal justice system is under-resourced and that the private protection industry has experienced a real boom in both countries. We can add that public police is notoriously corrupt in Brazil. Furthermore, both countries are stricken by very active illegal markets (drugs and arms trafficking)<sup>12</sup>, which generate high levels of violence. The fact that these illegal market activities are concentrated in the poorest neighborhoods which are themselves highly segregated respectively to the richest neighborhoods (condominio versus favela in Brazil, township versus central city in South Africa) may explain why violent crime victimization appears disproportionately concentrated on the poor in these two countries unlike the results obtained by Levitt (1999) for the United States.

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<sup>11</sup>That is the principal reason why violent crime victimization is considerably reduced for people living in a gated community: their isolation from the exterior is almost complete.

<sup>12</sup>See Oosthuysen (1998) and Gelbard (1998) for South Africa.

## 6 References

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