Policing, Schooling and Human Capital Accumulation

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Abstract

This paper addresses the importance of two public policies that commonly compete for government’s budget: schooling and policing. By means of a contest game, I discuss the individual decision to accumulate violence-related skills at the expense of human capital formation, in a setting where property rights require private efforts to be enforced. Additionally, I explore the existence of an optimal policy.

JEL Classification: D74—Conflict • Conflict Resolution • Alliances
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I am very grateful to all the members of my committee
1 Introduction

In order to survive in environments such as inner cities, where official agencies fail to ensure personal security, people have to learn ways to privately enforce property rights. Those skills have to do with violent behaviors that sometimes are referred as “The Code of the Street” (Anderson, 1999) or simply as "Street Capital" (Aliprantis, 2013). This observation along with the fact that becoming more productive at any carries an opportunity cost, establishes the existence of a trade-off: spending time at school leads to higher earnings, but reduces the ability to defend private property from others. Thus, it is clear that the expectation of future conflicts due to low public security levels should induce an unfortunate reallocation of resources from school to streets. But also importantly, increasing public security is costly and one can think that such a policy may affect the resources that could be available for investments in public education. Moreover, lowering the quality of education reduces incentives to accumulate human capital.

Therefore, the problem to be solved consists in determining what investment must carry a higher priority in the breakdown of the budget. It is not hard to find papers putting emphasis in one option or the other. For example, Lochner (2004) provides empirical evidence pointing out that education has itself the remedy against insecurity, where the economic logic is that improvements in future wages through human capital increases the opportunity cost of committing crimes. The discussion contained in Hjalmarsson and Lochner (2012) describes a number of papers that estimate the impact of average schooling attainment on crime measured as imprisonment rates and other related variables. The common denominator in that approach is the exploitation of natural experiments emerged as the result of changes on education laws in different countries. Besides the econometric technique, this literature is always concerned with high developed countries such as England, Sweden, Italy, and the United States. The general conclusion of this sort of contributions is that increasing the years of compulsory education decreases crime rates significantly, which is commonly used as an argument in favor of education over policing.

One could say that having a sample of high developed countries, and excluding explanatory variables concerned with security can lead to incorrect conclusions. First, highly developed societies enjoy the benefits of having institutions that guarantee a sufficient level of public security; therefore increments on wages via human capital investments are regarded as secured private property and indeed, disincentive crime rates. Second, compulsory education needs to be backed up with mechanisms that induce individuals to comply the official dispositions, in which case the individual decision to study plays not a very important role. If those mechanisms are absent, the perception on how likely is to enjoy the fruits of human capital investments might be an important factor determining the graduation rates.

A different story is presented in Aliprantis (2013), where an empirical analysis is conducted to measure
how exposure to violence during childhood is a strong predictor in future criminal behavior. In that paper, crime is conceived as the ultimate consequence of a distinct educational process, that is, accumulation of street capital which is defined as “The skills and knowledge useful for providing personal security in neighborhoods where it is not provided by state institutions”. One important conclusion is that in general, black individuals have higher probability of getting engaged in criminal behaviors, but it is also true that they are exposed to a lot of violence during childhood. Importantly, after controlling for variables as witnessing a murder, listening shotguns and so on; black males tend to get outcomes similar to their white counterparts. The reported estimations revealed that exposure to violence reduces high school graduation in around 10 percentage points and hours worked by up to 4 hours per week.

The contrasting points of view on how insecurity relates to education, raises the question on what policy is better, policing or schooling. In the following paragraphs I introduce a model in which forward looking individuals decide to attend school or to spend time learning the code of the street. This decision is taken under an expected contest over output, where street capital provides better chances of a victory. I explore the equilibrium outcomes of public investments on education versus public security and find that fostering human capital accumulation without security might have a null effect on school graduation. Indeed, I argue that the relative educational premium, that is the ratio of education returns between types plays a very important role in determining the time the agents decide to spend in school. Another conclusion is that increasing public security always induces people to accumulate more human capital. Consequently, an optimal breakdown of the government’s budget arises, such that an increment in public education needs to be backed up by an increment in public security to obtain an optimal level of productivity.

The model just described has a close relation with the literature known as Economics of Conflict. In particular the contest specification that I use was first introduced by Hirshleifer (1988) and further developed by Skaperdas (1992) and Skaperdas and Syropoulos (1997). In spirit, my approach runs parallel with Gonzalez (2005) who delineates the strategic reasons for which an agent would rationally avoid costless productivity improvements in places where property needs to be privately defended. In Gonzalez’s words, “The price of peace is poverty”. The logic underlying such a conclusion is clearly described in Garfinkel and Skaperdas (2006) in terms of the comparative advantage concept: increments in productivity raise the opportunity cost of fighting over a common pool of resources.
2 The model

2.1 Description of the economy

The setting consists of a continuum of individuals distributed along the interval $[0, 1]$ that resides in the "inner city", a place where many conflicts are potentially resolved out of the scope of formal justice. Each person is endowed with an innate learning skill $B_{\tau}$, that can take two values $\{B_l, B_h\}$ (thus, $\tau \in \{l, h\}$), where the probability of the event $\tau = h$ is $\alpha$. Each individual lives only for two periods that will be referred as childhood and adulthood. While being a child, people can allocate a unit of time between attending to school ($1 - g$ hours) and spending time with gangs ($g$ hours), the outcomes of this stage are the formation of human capital $H$ which will yield a higher future labor productivity and the accumulation of street capital $S$. Moreover, everyone initially is unaware of the specific type they have. According to the definition of street capital discussed in the introduction, $S$ can be interpreted as the ability to protect one's own property or take some one else’s by means of violent behavior.

In the second stage, the inner city residents are matched to one and only one neighbor in a particular geographic location. Simultaneously, the government randomly allocates police officers along the different neighborhoods such that the protection of a fraction $p$ of them is ensured. If a particular match ends up residing in a zone with police protection, no conflict arises. Alternatively, when living in an insecure area, the agents produce the consumption good and also get ready to fight over the output. In order to do so, they allocate their time between productive activities ($1 - z$ hours) and to exert violence ($z$ hours). Finally, consumption takes place according to the shares specified by a conflict technology $\Gamma$. As will be indicated shortly, the government can boost the formation of human capital by undertaking investments denoted by $E$, and it can also increase security by expanding the share of neighborhoods under police protection, $p$.

2.2 Equilibrium

The problem that a producer $i$ of type $\tau_i$ solves at $t = 2$ when he lives on a protected zone, is

$$\max \left\{ H_i (1 - z_i) \right\}_{0 \leq z_i \leq 1}$$ (p1)

Where the solution is trivially $z_i = 0$, and consumption is $c_i = H_i$. If the individual lives in an unprotected area, he will have to be aware of who lives next door, say a type $\tau_j$ agent. In this case the problem to be solved is:

$$\max_{0 \leq z_i \leq 1} \left\{ \Gamma (G_i, G_j) \sum_{k \in \{i,j\}} H_k (1 - z_k) \right\}$$ (p2)
Where $\Gamma(G_i, G_j) = G_i^m / (G_i^m + G_j^m)$ is the conflict technology that yields the share that agent $i$ is able to appropriate out of the common pool of resources composed by the total output produced by the couple $(i, j)$. This function depends on the participant’s violent actions. The parameter $m$ measures how effective is violence in determining the equilibrium shares. Also, the variable $G_i$ is the result of combining time $z_i$ and street capital such that $G_i = S_i z_i$. By direct inspection of problem (p2) is clear that every agent faces a trade off between producing more output or devoting time to fight. Now, such a trade off differs in intensity for both agents since each one of them posses a different set of skills. In fact, the most skillful producer is always the worst fighter since the marginal cost of increasing $z_i$ is greater for him. Therefore, as stated in Garfinkel and Skaperdas (2006), the comparative advantage in production translates into a comparative disadvantage in fighting. Consequently, if the productivity spread for couple $(i, j)$ is large enough, then specialization will show up as a corner solution to problem (p2).

During the first period, the inner city youths split their time between school and street activities to maximize the expected value of future consumption. The street and human capital are formed according with $S_i = F g_i$ and $H_i = f(E, B_{z_i}) (1 - g_i)$ where $f()$ is a function that combines public investments in education and innate learning abilities. The solution to the problems (p1) and (p2), can be expressed as a policy function that depends on the state variables that each individual faces as an adult, formally: $\rho = \{1$ if there is police protection, 0 otherwise$\}$, $\lambda_{ij} = [H_i, H_j, S_i, S_j]$ is the vector of human and street capital stocks and $\tau_{ij} = [\tau_i, \tau_j]$ stands for the vector of types involved in the match of individuals $i$ and $j$. The policy function that solves p1 and p2 is denoted by $G_i = G (\tau_{ij}, \rho, \lambda_{ij})$ and the resulting value function is represented by $C_i = C (\tau_{ij}, \rho, \lambda_{ij})$.

During childhood, the types, the realization of matches and the police protection status are unknown, whereas the vector $\lambda_{ij}$ is directly influenced by the agents, so we write $\lambda_{ij} = \lambda_{ij} (g_i, g_j)$. As a result of agents’s choices, a vector $g$ emerges as a strategy profile. For player $i$, a belief is also a vector $g_{-i}$. At this point is useful to Recall that the fate of any participant in this game is to be matched to one and only one neighbor, but when player $i$ thinks about the outcome of having agent $j$ as an opponent, he will consider five different possibilities: peaceful production, two possible asymmetric matches, and two symmetric matches.
(since \( \tau_{ij} \in \{(h,l) , (l,h) , (h,h) , (l,l) \} \)). We denote \( i \)'s expected consumption of facing \( j \) by \( V_{ij} \), thus:

\[
V_{ij}(C(\tau_{ij}, \rho, \lambda_{ij} (g_i, g_j))) = p \{ \alpha B_h (1 - g_i) + (1 - \alpha) B_l (1 - g_i) \} \\
+ (1 - p) \{ \alpha [\alpha C ((h,h), 0, \lambda_{ij} (g_i, g_j)) \\
+ (1 - \alpha) C ((h,l), 0, \lambda_{ij} (g_i, g_j))] \\
+ (1 - \alpha) [\alpha C ((l,h), \lambda_{ij} (g_i, g_j)) \\
+ (1 - \alpha) C ((l,l), 0, \lambda_{ij} (g_i, g_j))] \}
\]

Then, the first stage objective function is the average consumption for agent \( i \) given his beliefs \( g_{-i} \). Therefore, the problem that every child solves is:

\[
\max_{\{0 \leq g_i \leq 1\}} \int_{[0,1]/\{i\}} V_{ij}(C(\tau_{ij}, \rho, \lambda_{ij} (g_i, g_j))) dj \quad (p^*)
\]

**Definition 1** A Pure Strategy Bayesian Nash Equilibrium for this game consists of a second stage policy function \( G_i = G(\tau_{ij}, \rho, \lambda_{ij}) \), and a first stage policy function,

\[
g^*_i(g_{-i}) = \arg\max_{\{0 \leq g_i \leq 1\}} \int_{[0,1]} V_{ij} [C(\tau_{ij}, \rho, \lambda_{ij} (g_i, g_j))] dj
\]

for each agent in \([0,1]\) such that \( g^* = (g^*_i)_{i \in [0,1]} \) is a fixed point of the best response correspondence \( B(g) = (g_i(g_{-i}))_{i \in [0,1]} \).

Since we have homogenous agents at \( t = 1 \), it is natural to assume a symmetric equilibrium \( g_i = g^* \forall i \in [0,1] \).

### 2.3 Interior Solution

**Second Stage.** We solve the model backwards, meaning that the first task to address is to compute the first order conditions of problem (p2) and obtain the policy function for violence at \( t = 2 \). First, is important to notice that the conflict technology \( \Gamma_i \) (the share that \( i \) grabs), only depends on the ratio of violence levels used by the contestants, since it can be written as:

\[
\Gamma_i = \frac{1}{1 + \left( \frac{G_i}{G_l} \right)^m}
\]
Assuming an interior equilibrium, we obtain:

\[ \frac{G_i}{G_j} = \left( \frac{\theta_j}{\theta_i} \right)^{\frac{1}{m+1}} \]  

(1)

Where \( \theta_i = (H_i/S_i) \), that is the units of human capital that \( i \) has per unit of street capital. Therefore, the equilibrium shares are given by:

\[ \Gamma_i = \frac{1}{1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}}} \]  

(2)

Here, it is important to emphasize that equation (2) summarizes our discussion on the comparative advantage concept: that agent having more units of human capital per unit of street capital will be worse off. Actually, if we increase the value of \( \theta_i \), the after-conflict \( i \)'s share \( \Gamma_i \) decays. From hereafter, we will denote \( \omega_{ij} = \theta_i/\theta_j \) as the measure of comparative disadvantage in fighting that agent \( i \) suffers when he faces agent \( j \). The rest of the equilibrium outcomes are:

\[ G(\tau_{ij}, \rho, \lambda_{ij}) = \frac{(m)(H_i + H_j)^{1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}}}}{\theta_j \left( 1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}} \right)^{\frac{1}{m+1}}} (1 - \rho) \]  

(3)

\[ z_i(\tau_{ij}, \rho, \lambda_{ij}) = \frac{(m)(H_i + H_j)^{1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}}}}{H_i \left( 1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}} \right)^{\frac{1}{m+1}}} (1 - \rho) \]  

(4)

\[ Y = (H_i + H_j) \frac{1}{1 + m} \]  

(5)

The resulting value function is:

\[ C(\tau_{ij}, \rho, \lambda_{ij}) = \frac{(m)(H_i + H_j)^{1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}}}}{1 + \left( \frac{\theta_i}{\theta_j} \right)^{\frac{1}{m+1}}} (1 - \rho) + \rho H_i \]  

(6)

and the ratio of agents \( i \) and \( j \) consumptions yields:

\[ \frac{C_i}{C_j} = \left( \frac{\theta_j}{\theta_i} \right)^{\frac{m}{m+1}} \]  

(7)

First Stage. After plugging (6) into \( V_{ij} \), we can compute the first order conditions for problem \( \left( p^* \right) \) which are:

\[ \int_{[0,1]/\{i\}} \frac{\partial V_{ij}}{\partial g_i} \, dj = 0 \]
Assuming a symmetric equilibrium, i.e. \( g_i = g_j, \forall (i, j) \in [0, 1]^2 \) yields:

\[
\frac{\partial V_{ij}}{\partial g^*} = 0
\]

where \( g^* \) is the equilibrium time allocation to street activities. It is worth noting that \( g^* \) depends only on the parameters \( p, \alpha \) and the ratio of second stage productivity \( f(E, B_h)(1 - g^*)/f(E, B_l)(1 - g^*) \), or simply \( f(E, B_h)/f(E, B_l) \) that will be denoted by \( \omega \) (therefore we write \( g^*_i = g^*(\alpha, p, \omega) \)). Now, \( \omega \) is the relative educational premium in the symmetric equilibrium, and by our discussion on the first stage problem, it also denotes the equilibrium comparative disadvantage in fighting that agents of type \( h \) exhibit. The following result is an immediate consequence of the observations made in this paragraph, and specifies the condition under which the time that the inner city youths devote to learn the code of the street does not react to higher levels of public education investments.

**Proposition 2** In the symmetric equilibrium, if \( \frac{\partial \omega}{\partial E} = 0 \), then \( \frac{\partial g^*}{\partial E} = 0 \). Additionally, \( \frac{\partial g^*}{\partial p} < 0 \)

The fact that public education investments can only affect \( g^* \) by changing the value of \( \omega \), follows directly from the conflict technology \( \Gamma \) and equation (1). Indeed, the output shares the contestants get, will ultimately depend on the ratio \( \omega_{ij} = \theta_i/\theta_j \), in the sense that the most productive agents will have a higher opportunity cost of fighting over the output. Therefore, increasing \( E \) in the symmetric equilibrium will change people’s decisions over \( g^* \) in the first stage depending on the direction of change in \( \omega \) and the value assigned to the parameters \( \alpha \) and \( m \). For example, if \( p \) is very low and investments in public education increase the relative educational premium \( \omega \), then the agents will anticipate that if they happen to be of type \( h \), the resultant share that they would appropriate will be too low compared to the increment in output via a higher \( E \). Then, if the likelihood of asymmetric conflicts is large enough, an increment on \( E \) might induce a higher \( g^* \).

Thus, as the previous discussion suggests, the government does not have an easy task while deciding what policy, education or policing, will yield the best outcomes.

It is useful to interpret \( g^* \) as the first-stage investment in violence that equates the expected marginal benefit of an extra unit of street capital to the marginal cost of losing productivity via human capital, whenever the rest of the youths are choosing \( g^* \) (recall that \( g^* \) is the symmetric equilibrium profile). The reason for which nobody wants to deviate towards a lower \( g^* \) is that this would represent an increment in the produced output that not only won’t be enjoyed, but will compromise extra units of consumption via lowering the ability to produce violence. Also, nobody would be willing to become more proficient in fighting for it would reduce too much the productivity that given the level of police protection, also yields some expected utility. Therefore, as stated in the previous proposition, increasing \( p \) will always induce the society
2.4 Specialization

As the value of $\omega$ increases, the least productive type will enjoy a stronger advantage in fighting (see equation 2). Thus, it is natural to anticipate that if $\omega$ is high enough, then $z_l$, the time that the low type devotes to exert violence eventually hits the constraint $z_l \leq 1$. In fact,

$$z_l = \frac{m}{m+1}(1 + \omega) \rightarrow \infty \text{ as } \omega \rightarrow \infty, \forall m > 0$$

(8)

Now the problem is to compute the value of $\omega$, say $\omega^*$, such that $z_l < 1$ iff $1 < \omega < \omega^*$. To pin down this threshold it suffices to solve the inequality $z_l < 1$ using (8), which yields the condition:

$$\left( \frac{m}{m+1} \right) \omega - \omega^{m+1} < \frac{1}{m+1}$$

(9)

Denote the LHS of (9) by $h(\omega)$. Then it is easy to verify that $h(1) < 0 \forall m$, implying that problem (p2) will have exclusively interior solutions whenever we consider only one type. It is also easy to corroborate that $h$ is increasing and convex for all $\omega \geq 1$, and that it increases without bound in $\omega$. Since it is not possible to offer an explicit formula of $\omega$ in terms of $m$, one needs to use numerical methods to compute the threshold $\omega^*(m)$ for different levels of violence effectiveness.

Figure 1 shows that the threshold $\omega^*$ increases in the effectiveness parameter $m$. The intuition is that as $m$ goes up, the marginal benefit of exerting violence is greater for any $\omega$, inducing agents of type $l$ to allocate more resources towards appropriation. Hence, the value of $\omega^*$ has to decrease. In the following proposition, it is shown that for a fixed $m$, the low type will monotonically specialize in violence as $\omega$ approaches $\omega^*$. 

![Figure 1](image-url)
Proposition 3 If $\omega < \omega^*(m)$, then $\frac{\partial z_h}{\partial \omega} > 0$.

Now, for the high type, we won’t observe full specialization, actually:

$$z_h = \frac{m+1}{m+\frac{1}{\omega}} \left(1 + \frac{1}{\omega}\right) \rightarrow \frac{m}{m+1} \quad \text{as} \quad \omega \rightarrow \infty, \quad \forall m > 0 \quad (10)$$

The behavior of $z_h$ is better understood when we rewrite it’s value as $z_h = (1/\omega)^{m+1} z_l$. It follows that when $\omega$ increases, two opposed effects will determine the value of $z_h$ since $z_l$ will grow but $(1/\omega)^{m+1}$ will decrease. This two effects will continue to operate until the constraint $z_l \leq 1$ binds (that is, when $\omega > \omega^*(m)$). Nevertheless, the next proposition ensures that $z_h$ decreases monotonically while $\omega$ approaches $\omega^*(m)$, meaning that the negative effect just described prevails.

Proposition 4 If $\omega < \omega^*(m)$, then $\frac{\partial z_h}{\partial \omega} < 0$

After $\omega$ grows beyond $\omega^*$, type $l$ specializes in exerting violence, such that $z_l = 1$. The value of $z_h$ is determined by the equation:

$$\left(\frac{S_h}{S_l}\right)^{m+1} z_h^m + (1 + m)z_h = m$$

In the special case when $m = 1$, we have that $z_h = -1 + \sqrt{2}$. The following figure plots the specialization process for both types.

The conclusions presented in this section should be interpreted in the following way: whenever the adulthood inequality increases, the high type agents will make less use of their street skills acquired during childhood; while the opposite situation will be observed for their low productive counterparts. Therefore, if the inner city children perceive both, a higher probability of becoming into a highly productive adult and an increment
in the relative return to education, they will tend to decrease their investments in street capital. This observation will be cardinal to understand the numerical results shown in Section 3.

2.5 The behavior of $g^*$

As explained before, the formula of $g^*$ is complicated and taking derivatives is not straightforward. But it is worth noting that the model is the mixture of three problems: peaceful production, production under symmetric conflicts and production under asymmetric conflicts. Therefore one can find simpler but useful expressions for $g^*$ by reducing the model in different directions. First, I will examine how the value of $g^*$ reacts to changes in the relative educational premium, $\omega$, in a context where there are only two agents that always assume different types at the second stage. Second, we will look to the role of education and policing when there is no heterogeneity. This procedure is adequate if we conceive public education as a policy intervention that does not change inequality.

2.5.1 Heterogenous agents

In this section we will look at $g^*$ when the adulthood productivity ratio $\omega$ increases. As we already showed in section 2.3, $\omega$ determines the comparative disadvantage in exerting violence that a high type agent suffers. We also proved that as $\omega$ increases towards $\omega^*(m)$, the high type agents will gravitate towards lower levels of violence whereas their low counterparts will fully specialized themselves in grabbing activities. Therefore, the stock of street capital will be increasingly useless for high type agents and more profitable for low type adults.

In order to isolate the role of asymmetric conflicts in determining the value of $g^*$, I will use a simplified version of the general model. Let's assume that there are only two agents, 1 and 2 that will have different types with probability one, but there is uncertainty on what specific type they will adopt. To keep the applicability of the symmetric equilibrium, we impose the probabilities of the events \(\{\tau_1 = h, \tau_2 = l\}\) and \(\{\tau_1 = l, \tau_2 = h\}\) to be .5 (otherwise each agent would face a different problem at stage 1). Additionally, assume that with probability $p$ the neighborhood in which they live enjoys police protection. In this case, the time allocated to learn street-related skills is:

\[
g^* = \begin{cases} \frac{2m}{(m+1)^2} & \text{if } p > 0 \\ \left(\frac{1}{2} + \frac{1}{z_1}\right) \left(\frac{1}{z_1} + \frac{1}{z_2}\right) + \left(\frac{p}{1-p}\right) \left(1 + \omega \frac{m}{m+1}\right) \left(1 + \frac{\omega m}{m+1}\right) & \text{if } p = 0 \end{cases} \]

Equations (11.a) and (11.b) are enlightening. When $p = 0$, the time the inner city’s society allocates to
learn the code of the street depends on the ultimate outcome of two opposed forces: the decreasing level of
violence that high type agents will use and the specialization towards grabbing for low type agents. Equation
(11.b) shows that when $\omega$ increases, the denominator of (11.b) will increase or decrease depending on how
intense is the change in $z_h$ and $z_l$ (see equations (8) and (10)). Given the results in section 2.4, the reaction
of $z_l$ will increase $g^*$, whereas $z_h$ will yield the opposite effect. Since $z_l$ grows faster than $z_h$ decays, it follows
that $g^*$ will increase as a consequence of an increment in $\omega$, a fact that will be referred as the "specialization
effect". Figure 2 contains some numerical experiments that illustrate this conclusion.

![Figure 2.a](image1)

**Figure 2.a** Time Devoted to Accumulate
Street Capital $\alpha=.5$, $p=0$

![Figure 2.b](image2)

**Figure 2.b** Time Devoted to Accumulate
Street Capital $\alpha=.5$, $p=.5$
The pattern observed in Figure 2a reveals that people will spend more time preparing themselves for violent conflicts at the expense of education, if the relative return to the latter increases during adulthood. Therefore, if public education has the property of increasing the value of \( \omega \), then higher levels of \( E \) will have two simultaneous effects: they will increase the output level produced by any pair of individuals for every value of \( g^* \), but it will also induce people to spend more time accumulating street capital. Hence, it might be the case that investing on public education could be itself a way to damage the total productivity of the system through lowering \( g^* \). Alternatively, if public education reduces the relative educational premium, increasing \( E \) might induce the agents to spend more time in schools, reducing the violence levels and fostering total productivity.

Importantly, if some police protection is around, the level of \( g^* \) is governed by equation (11.a). In this case, the second term in the denominator of \( g^* \) (which increases in \( \omega \geq 1 \) ) becomes more relevant when \( p \) approaches 1. Therefore, if \( p \) is higher, increments in \( \omega \) are more likely to reduce the value of \( g^* \). This conclusion is also interesting in the sense that it shows a nontrivial interaction between the policies under discussion. Figure 2b shows the evolution of \( g^* \) as \( \omega \) increases when 50% of the neighborhoods are protected.

2.5.2 Homogenous agents

In this subsection we take care of \( g^* \) when there is no heterogeneity at all. Therefore we set \( \omega = 1 \), so the value of \( B \) becomes irrelevant. Given the discussion in the previous section, the second stage problem always entails an interior solution. The corresponding formula for the time devoted to learn the code of the street is:

\[
g^* = \left( \frac{2m}{m+1} \right) \left( \frac{1-p}{pm+1} \right)
\]

where

\[
\frac{\partial g^*}{\partial p} < 0 \quad \text{and} \quad \frac{\partial g^*}{\partial m} < 0 \iff m > \left( \frac{1}{p} \right)^{\frac{1}{2}}
\]

What this result tells us is that police protection will always reduce the value of \( g^* \), since street capital is only useful where conflicts are allowed. Additionally, if \( p = 0 \), increments in \( m \) will yield a higher \( g^* \) since the use of violence becomes more effective and with probability one those street skills will be used. But if the level of police protection grows, then \( g^* \) might react negatively to higher levels of \( m \), since investments in human capital will be more protected and more effective weapons allow for a lower utilization of violence without damaging the equilibrium shares.

In order to observe the effects of reallocating more resources to public education at the expense of public security, we run the following experiment: Suppose that the value of the tax revenue \( T \) is divided between
spending in policing $T^p$ and schooling $T^e$, such that $T = T^p + T^e$. Moreover, denote the fraction $T^e/T = \mu$, and $T^p/T = 1 - \mu$. Now, the government generates higher values of $p$ and $e$ by means of the following technologies:

\[
p(T^p) = \min \left\{ \frac{T^p}{T^e}, 1 \right\}
\]
\[
E(T^e) = T^e + (1 - \mu) E_{\text{min}}
\]

or simply

\[
p(T^p) = \min \left\{ (1 - \mu) \frac{T^p}{T^e}, 1 \right\}
\]
\[
E(T^e) = \mu T + (1 - \mu) E_{\text{min}}
\]

The parameter $T^*$ represents the amount of resources needed to secure 100% of the inner city neighborhoods, whereas $E_{\text{min}}$ is the return of public education when no investments are undertaken by the government in that area. For simplicity, let’s assume that $T^* = T$ and $E_{\text{min}} = 1$. The problem that the government solves consists in choosing $\mu \in [0, 1]$ to obtain the maximum expected output:

\[
E(Y) = p(f(E, B)) (1 - g^*) + (1 - p) \left( \frac{1}{m + 1} \right) f(E, B)(1 - g^*)
\]

When $f(E, B) = EB$, the optimization problem to be solved is:

\[
\max_{0 \leq \mu \leq 1} \left\{ \mu (T - 1) + 1 \right\} B \left\{ \frac{(1 - \mu) m + 1}{m + 1} - \frac{2m\mu}{(m + 1)^2} \right\}
\]

and the optimal fraction of spending on education is

\[
\mu^* = \frac{[(T - 1) + (T - 2) m] [m + 1] - 2m}{2m (T - 1)(2 + m)}
\] (12)

It is straightforward to check that if $m = 1$, then $\mu^* < 1$ for all $T > 0$, ensuring the existence of an interior optimal breakdown of the budget. Thus, there are scenarios for which investing in policing, even when it comes at the expense of education, is optimal. The reason is that the output will grow at a constant rate as we increase the value of $E$ (see equation (5)), but investing on policing will induce higher allocations of time to form human capital formation. It turns out that discouraging $g^*$ will yield a better outcome for the first $(1 - \mu^*)$ dollars. Another way to express the idea behind equation (12), is that every improvement in human capital needs to be backed up with some guarantees that it will be possible to enjoy the fruits of it.
3 Results

3.1 Summary of partial results

So far we have established two important observations in the context of simpler versions of the model:

1. Investing in policing (increasing $p$) will always induce the agents to allocate more time towards education.

2. Public education might have mixed results.

(a) First, if the relative education premium $\omega$ does not depend on $E$, then $g^*$ will also be independent of $E$, in which case, increments on $E$ will foster production by increasing the agent’s productivity per unit of time spent in schools. Now, if those investments come at the expense of policing, the output will fall due to higher levels of $g^*$.

(b) If education also increases the value of $\omega$, then an increment on $E$ will trigger two mechanisms: the low type agents will specialize themselves in exerting violence and for that reason, their childhood investments on street capital will yield a higher return for them. The high type agents will reduce the utilization of violence, so in their case, spending more time in schools would be optimal. Since the inner city youths ignore their own type before choosing $g^*$, they will try to forecast how useful each one of the capital varieties will be for them. To do so, they use the probability of being forced to fight $(1 - p)$, and the fraction of high type agents $\alpha$. It is important to recall that using a simplified version of the model we conjectured that whenever the fraction of low type $(1 - \alpha)$ decreases, the time spent on learning the code of the street must go down since the chances of being an effective fighter decrease.

In this section, using the complete model, we corroborate the validity of the partial results just discussed by means of numerical experiments.

3.2 Numerical Experiments

3.2.1 Existence of an optimal policy

Here we reproduce the experiment presented in section 2.5.1 by setting $T^* = T = 2$, $E_{\text{min}} = 1$ and assuming that $\omega$ is independent of $E$. That is, the government can provide public security to 100% of the inner city neighborhoods if the entire tax revenue is assigned to policing. Alternatively, if the fraction $\mu$ devoted to public education grows from 0 to 1, the value of $E$ grows from 1 to 2. Figures 2.1 and 2.2 show the expected
inner city’s output as the government invest 100% of resources in policing and gradually increases $E$ at the expense of public security. As anticipated, an optimal breakdown of the budget emerges. Also importantly, as $\alpha$ increases, the optimal fraction devoted to policing goes down.

### 3.2.2 A larger fraction of high type agents reduces the level of violence

Figure 4 shows that, as expected, when there are more chances for the agents to adopt the high type, the investments on street capital diminish. The intuition is that violence will be useless for a larger fraction of the population.

### 3.2.3 Increasing the relative educational premium has heterogenous effects on the level of violence

Figure 5.1, shows that when $p = 0$, $g^*$ can increase or decrease in $\omega$ depending on the fraction of high type agents. If $\alpha = 10\%$ then $g^*$ increases in $\omega$ for two reasons. First, there will be a lot of skillful fighters in the...
future, and second, in any asymmetric match the low type agents will tend to make better use of violence as \( \omega \) increases. Nevertheless, the amount in \( g^* \) is rather mild since the likelihood of symmetric matches are also higher. Recall that in symmetric matches, specialization never takes place (see section 2.4). Finally, when \( \alpha = 25\% \), we observe the opposite result, \( g^* \) decreases in \( \omega \), where the intuition is obtained by reversing the logic of the argument just discussed.

Figure 5.2, shows that if the fraction of secured neighborhoods increases to 50\%, then \( g^* \) decreases in \( \omega \) for different values of \( \alpha \). The reason is that once \( p \) is high enough, the "specialization effect" becomes negligible. In fact, equation (11.a) shows that as \( p \) increases, the term \( (1 + \omega^{m/m^*}) \left( 1 + \omega^{m/m^*} \right) \) weights more in determining the value of \( g^* \), diminishing the importance of the term \( \left( \frac{1}{z^T} + \frac{1}{z^T} \right) \), which summarizes the "specialization effect".

4 Conclusion

In principle there is no reason to assume that investments in education should always have priority over those ones in public security. Indeed, both policies interact with each other since one increases the returns of education and the other allows the agents to enjoy the fruits of accumulating human capital. In the model presented in this paper I explored the reaction of the incentives to study or to accumulate street skills in places where property rights are no fully guaranteed by a public agency. The equilibrium prediction of the model is that the decision to remain more time in schools depends on the productivity ratio of adult agents. Therefore, public education will modify the incentives to accumulate human capital if and only if it can change the productivity inequality, in which case the results of that policy might depend on the distributions of types. Therefore the size of the social conflict (measured by the accumulation of street skills) can be increased by public education in some cases and decreased in some others.
Also importantly, the model suggests the existence of an optimal breakdown of the government’s budget, which means that some spending in policing is optimal even when it comes at the expense of public education. The existence of this optimal fraction arises from the fact that policing induces children to allocate more time to education and reduces the time spent on learning the code of the street.

One needs to keep in mind that there is one important dimension not taken into account in this paper. It is commonly accepted in the literature of Economics of Conflict, that people don’t internalize the social cost of exerting higher levels of violence at the individual level (Gonzalez, 2010). One could think that during violent conflicts some collateral damages are observed, and that they can be measured in output units, that is, part of the production is destroyed as a result of violent confrontations. Another way to address externalities coming from violent appropriation can be achieved assuming that each agent is attacked with the average amount of weapons in the economy, then each agent while investing in street capital would be also operating against himself since part of that street skills will be used to strip him out of his output. The importance of this feature might be very consequential for the analysis presented in this paper, since higher investments in public education without police protection might induce intolerable levels of conflict.

5 References


6 Appendix

6.1 Proof of proposition 2

Note that \( \frac{\partial z_i}{\partial \omega} > 0 \) iff

\[
(1 + \omega^\frac{m}{m+1}) - (1 + \omega) \left( \frac{m}{m+1} \right) \omega^{-\frac{1}{m+1}} > 0
\]

\[\iff\]

\[
1 - \frac{m}{m+1} \omega^{-\frac{1}{m+1}} - \frac{m}{m+1} \omega^{-\frac{m}{m+1}} > -\omega^{-\frac{m}{m+1}}
\]

\[\iff\]

\[
\frac{m}{m+1} \omega + 1 > \frac{m}{m+1} \omega + 1 - \frac{m}{m+1} \omega^{-\frac{1}{m+1}} - \frac{m}{m+1} \omega^{-\frac{m}{m+1}} > \frac{m}{m+1} \omega - \omega^{-\frac{m}{m+1}}
\]

then

\[
\frac{m}{m+1} \omega - \omega^{-\frac{m}{m+1}} < \frac{m}{m+1} \omega + 1
\]

But in any interior equilibrium equation (8) holds, so we have:

\[
\frac{m}{m+1} \omega - \omega^{-\frac{m}{m+1}} < \frac{1}{m+1} < \frac{m}{m+1} \omega + 1 \ \forall \ \omega > 1
\]

It follows that in any interior equilibrium \( z_i \) will be increasing in \( \omega \).

6.2 Proof of proposition 3

Note that \( \frac{\partial z_h}{\partial \omega} < 0 \) iff

\[
\omega^{-\frac{1}{m+1}} + \omega - (\omega + 1) \left( \frac{1}{m+1} \omega^{-\frac{m}{m+1}} + 1 \right) < 0
\]

\[\iff\]

\[
\frac{m}{m+1} \omega - \frac{1}{m+1} \omega^{-\frac{m}{m+1}} < 1
\]

\[\iff\]

\[
\frac{m}{m+1} \omega - \omega^{-\frac{m}{m+1}} < \frac{1}{m+1}
\]

Therefore, if equation (8) holds \( z_h \) will be decreasing in \( \omega \).