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ABSTRACT

This paper offers an explanation for observed differences across countries in educational policies and in resulting interpersonal distributions of human capital, analyzing a general-equilibrium model in which, as a result of differences in natural ability and nurturing, some people are initially well-endowed with human capital and some are initially poorly-endowed. It assumes that people can choose to be either producers or predators. Because an increase in a person's human capital makes predation a less attractive choice, it is possible that by using some of their human capital to educate initially poorly-endowed people, well-endowed people can increase their own consumptions. It is predicted that if producers are able to enforce a collective choice that takes advantage of the deterrent effect of allocating resources to guarding against predators, then well-endowed people prefer an egalitarian educational policy that increases the human capital of all poorly-endowed people. Such an educational policy either decreases the cost of deterring predation or makes deterrence possible. In contrast, if producers or small subsets of producers individually choose the amount of their resources to allocate to guarding, taking the ratio of predators to producers as given, then well-endowed people prefer an elitist educational policy that, if it has a redistributional component, decreases the number of poorly-endowed people, thereby decreasing the number of predators, without increasing the human capital of the remaining poorly-endowed people. (Author/SM)

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Abstract

This paper offers an explanation for observed differences across countries in educational policies and in resulting interpersonal distributions of human capital. We analyze a general-equilibrium model in which, as a result of differences in natural ability and nurturing, some people are initially well endowed with human capital, whereas other people are initially poorly endowed with human capital. We assume that people can choose to be either producers or predators. Because an increase in a person's human capital makes predation a less attractive choice for that person, it is possible that by using some of their human capital to educate the initially poorly endowed people the well endowed people can increase their own consumption. More interestingly, our theory predicts that, if producers are able to enforce a collective choice that takes advantage of the deterrent effect of allocating resources to guarding against predators, then the well endowed people prefer an egalitarian educational policy that increases the human capital of all of the poorly endowed people. Such an educational policy either decreases the cost of deterring predation or makes deterrence possible. In contrast, if producers or small subsets of producers individually choose the amount of their resources to allocate to guarding, taking the ratio of predators to producers as given, then the well endowed people prefer an elitist educational policy that, if it has a redistributional component, decreases the number of poorly endowed people, thereby decreasing the number of predators, without increasing the human capital of the remaining poorly endowed people. These implications seem to be consistent with the facts about differences across countries in educational policy.

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> Mr. Benson looks to the future and sees a widening social abyss. "We could get to a situation similar to Manila, where the upper and middle classes surround themselves with walls and security guards to protect themselves from an abandoned underclass." ... When asked about Mr. Benson's fear of an urban America that looks like Manila, Mr. Newsome shrugs: "It's already like that," he says. (*The Wall Street Journal,* September 26, 1995, page A8.)

Although almost every modern state provides either public education or public subsidies for education, casual observation reveals that differences in educational policy result in large differences across countries in the interpersonal distribution of human capital. Most notably, in Western European countries and in some East Asian countries, like Japan, Korea, Singapore, and Taiwan, every person receives a good enough education to insure that almost everyone is at least functionally literate. In these countries the resulting distribution of human capital is relatively egalitarian. In contrast, in many of the countries of South America, Africa, and Asia, including the Philippines, and, as Mr. Newsome suggests, also in the United States, educational policy is elitist. In these countries, while some people receive higher education and acquire a large amount of human capital, many other people receive little or no effective education and do not even achieve functional literacy. These people constitute "an abandoned underclass" to which Mr. Benson refers. This paper proposes a positive theory that suggests why educational policy is egalitarian in some countries but elitist in other countries.

1. Educational Policy and the Predatory Threat

Our analytical framework is a general-equilibrium model in which, as a result of differences in natural ability and in nurturing, some people are initially well endowed with human capital, whereas other people are initially poorly endowed with human capital. In this model the interpersonal distribution of human capital has two dimensions. One dimension is the endowment of human capital of a poorly endowed person relative to a well endowed person.

The other dimension is the fraction of people who are poorly endowed.

An egalitarian educational policy has a redistributional component that increases the human capital of the initially poorly endowed people relative to the human capital of the initially well endowed people,. An elitist educational policy, in contrast, may or may not have a redistributional component. If an elitist educational policy has a redistributional component, then it decreases the fraction of people who are poorly endowed without increasing the human capital of the remaining poorly endowed people.

We assume that the well endowed people make a collective choice of educational policy, and that the policy that they choose maximizes their own consumption. We regard this view that donors selfishly determine the extent and form of redistribution to be more realistic, even in "democracies", than the popular median-voter model of redistribution. Also, we assume that the cost of receiving a publicly financed education, which would include the opportunity cost of time spent in school, is small enough that an initially poorly endowed person would accept any offer of publicly financed education.

To theorize about the choice of educational policy we focus on the predatory threat posed by people who are poorly endowed with human capital. To analyze this predatory threat we allow people to choose to be either producers or predators, predators being people who produce nothing, but live by appropriating the product of the producers.

We assume that each person chooses to be either a producer or a predator depending on whether production or predation is more lucrative for him (or her).[1] We also assume

[1]Dan Usher (1987) developed a pioneering general-equilibrium model in which, as in the present model, people choose whether to be producers or predators and producers decide how much time and effort to put into guarding against predators. In another paper — Grossman and Kim (2000) — we analyze the choices of people to be producers or predators in a model in which only some people, whom we define to be amoral, are potential predators. The other people, whom we define to be moral, always choose to be producers, no matter how lucrative predation is relative to production. Usher (1997) assumes that education can increase the fraction of people who are moral. In the present paper we assume that everybody is amoral. Assuming that some people are moral would not change the main predictions about educational policy.

that being a predator is a more attractive choice for a poorly endowed person than for a well endowed person. To implement this assumption as simply as possible, we assume specifically that a person's human capital enhances his ability to produce, but does not enhance his effectiveness as a predator. Given this assumption, and given that human capital is inalienable, a person benefits from a larger endowment of human capital only by choosing to be a producer.[2]

The predatory threat posed by poorly endowed people negatively affects the well endowed people in two ways: First, unless predation is deterred, producers lose some of their production to predators. Second, to reduce these losses, producers allocate some of their potentially productive human capital to guarding against predators.

In general, guarding against predators includes all actions that are costly but have the effect of decreasing the fraction of production lost to predation. Examples of ways of guarding include the locating of production in inconvenient but secure places, the production of things that are harder for predators to appropriate, the installation of locks, the building of walls, the hiring of private security guards, and the organizing of a police force. For simplicity, our analysis focuses only the total amount of human capital allocated to guarding, abstracting from different ways of guarding.[3]

The negative effects of predation connect to educational policy because the well endowed people can mitigate the threat of predation by using some of their human capital to educate those people who are initially poorly endowed with human capital.[4] The form of this

[2]This formulation implies that our analysis focuses on low-skilled predatory activities like burglary, robbery, and kidnaping. We implicitly abstract from high-skilled predatory activities like embezzlement and some forms of litigation.

[3]Although the model does not explicitly consider the apprehension and punishment of predators, we could easily extend the analysis to allow that apprehension and punishment by decreasing the expected utility of predators would make the choice to be a predator less attractive.

[4]In related papers Grossman (1994, 1995) considered the possibility that a propertied class would respond to the threat of predation either by redistributing land or by subsidizing wages to induce potential predators

mitigation, however, depends on whether educational policy is egalitarian or elitist.

An egalitarian educational policy makes production more lucrative for all of the poorly endowed people. In this way, an egalitarian educational policy decreases the amount of guarding against predators that is necessary to deter poorly endowed people from choosing to be predators. In contrast, an elitist educational policy, if it has a redistributional component, decreases the number of people for whom predation is more lucrative than production, and thereby decreases the number of people who choose to be predators.

2. Collective Choice of Guarding

In addition to distinguishing between countries with egalitarian and elitist educational policies, our analysis also distinguishes countries in which the allocation of resources to guarding against predators mainly depends on individual choices from countries in which the decision to allocate resources to guarding against predators is largely made collectively. An individual producer, or a small subset of producers, who chooses the amount of guarding takes the choices of other people to be either predators or producers as given. In contrast, a collective choice of the amount of guarding has the strategic advantage of taking into account the deterrent effect of guarding on the choice of people to be predators.

Notwithstanding this strategic advantage, the enforcement of collective choices is always problematic. To be concrete, we can think of government as being the agent to whom

to allocate more time to production. In another related paper, Ayşe İmrohoroğlu, Antonio Merlo, and Peter Rupert (2000) consider the interaction between redistributive policy and the apprehension of predators. None of these papers focuses on educational policy or addresses the central issue in the present paper, which is why educational policy is egalitarian in some countries but elitist in other countries. Other authors have shown that externalities in production can induce well endowed people to subsidize the education of poorly endowed people, even in the absence of a predatory threat. For example, François Bourguignon and Thierry Verdier (2000) emphasize production externalities in a model in which education enhances the ability of poorly endowed people to pose a political threat to well endowed people. In the present paper we focus the analysis by assuming that well endowed people have an incentive to educate poorly endowed people only to mitigate the predatory threat from the poorly endowed people.

producers assign the task of enforcing a collective choice of the amount of guarding, with taxation being the means of enforcement. A government's limited ability to enforce this collective choice would reflect limited ability to collect taxes from producers.[5]

We consider three possible cases. In the first case, limited ability to enforce a collective choice of the amount of guarding does not impose a binding constraint. In the second case, limited ability to enforce a collective choice imposes a binding constraint, but with an appropriate redistributive educational policy this constraint is not tight enough to negate the strategic advantage of collective choice. In the third case, the ability to enforce a collective choice of the amount of guarding is so limited that the strategic advantage of collective choice is lost. In this third case producers, or small subsets of producers, individually choose the amount of guarding.

Casual observation suggests that Western European countries and some East Asian countries, like Japan, Korea, and Singapore, and Taiwan, provide examples in which the amount of guarding against predators is largely chosen collectively. Interestingly, we have already observed that these same countries have egalitarian educational policies that provide even the poorly endowed with a relatively good education. In contrast, other countries, mainly in South America, Africa, and Asia, including the Philippines and, as suggested in the opening quotation, perhaps also the United States, provide examples in which the amount of guarding mainly depends on the choices of individual producers or small subsets of producers. Even more interestingly, we have observed that these countries have elitist educational policies that give some people an excellent education and other people little or no education.

[5]In this analysis we for a binding constraint on the ability to enforce a collective choice of the amount of guarding against predators, but we abstract from the possibility that the well endowed people face a binding constraint on their ability to enforce their collective choice of an educational policy. A possible rationale for this combination of assumptions is that a collective choice of educational policy involves only the well endowed people, whereas a collective choice of the amount of guarding involves all of the producers, who can include poorly endowed people in addition to well endowed people, and, hence is more difficult to enforce.

These examples suggest that egalitarian educational policies are associated with collective choice of guarding, whereas elitist educational policies are associated with individual choice of guarding.

Our analysis provides an explanation for these associations. We will see that, if producers collectively choose the amount of guarding against predators, then the well endowed people prefer an egalitarian educational policy. In contrast, if producers individually choose the amount of guarding against predators, then the well endowed people prefer an elitist educational policy.

3. A Formal Model

Let K denote the human capital of each well endowed person, and let k denote the human capital of each poorly endowed person, where $K \geq k > 0$. Let U denote the ratio of poorly endowed people to well endowed people. The fraction of people who are poorly endowed equals $U/(1+U)$, and the fraction of people who are well endowed equals $1/(1+U)$. Aside from their endowments of human capital, people are otherwise identical. The average endowment of human capital, denoted by Ω, is

$$\Omega = \frac{1}{1+U}\ K + \frac{U}{1+U}\ k.$$

Let e, where $0 \leq e < 1$, denote the fraction of his human capital that each well endowed person allocates to educating people who are initially poorly endowed with human capital. The variable e captures the redistributional component of publicly financed education.[6] Assuming that each unit of human capital allocated to education produces one additional unit of human capital, Ω is related to the average initial endowment of human capital,

[6]This formulation restricts the redistributional component of educational policy to be from the well endowed to the initially poorly endowed. This restriction accords with our concern with whether or not the initially poorly endowed are "an abandoned underclass". In a different context Raquel Fernandez and Richard Rogerson (1995) suggest that partial public funding of higher education can involve a redistribution from poorer to richer people.

denoted by Ω_o, according to

$$\Omega = \Omega_o + \frac{eK}{1+U}.$$

Equating these two expressions for Ω and rearranging, we obtain

$$(1-e)K = \Omega_o + U(\Omega_o - k). \tag{1}$$

According to equation (1), for a given value of Ω_o, the combination of U and k determines $(1-e)K$, the amount of human capital that each well endowed person has available for the production of consumables. Thus, the combination of U and k defines an educational policy and also fully describes the interpersonal distribution of human capital.[7]

Given the amount of human capital that he (or she) has available for production each person must choose whether to be a producer or a predator. Let N denote the fraction of people who are well endowed and who choose to be producers, let n denote the fraction of people who are poorly endowed and who choose to be producers, and let R denote the ratio of predators to producers. The fraction of people, whether well endowed or poorly endowed, who choose to be predators equals $R/(1+R)$, which is identical to $1-N-n$.

If a person chooses to be a producer, then he allocates his human capital between production and guarding against predators. Let G denote the ratio of the human capital that a producer allocates to guarding against predators to the human capital that he allocates to the production of consumables. The fraction of his human capital that a producer allocates to guarding equals $G/(1+G)$, and the fraction of his human capital that a producer allocates to production equals $1/(1+G)$.

As discussed above, the choice of G can be made either collectively or individually. Let $\overline{G}$ denote the maximum collective choice of G that producers can enforce. We take $\overline{G}$ to be an exogenous variable, leaving the project of endogenizing $\overline{G}$ for another time.

[7] If each unit of human capital allocated to education produces λ additional units of human capital, where λ is positive but not necessarily equal to one, then equation (1) generalizes to $(1-\lambda e)K = \Omega_o + U(\Omega_o - k)$. All of the qualitative conclusions derived below obtain whether or not λ equals one.

To simplify the analysis of the choice between being a producer or a predator, assume that a unit of human capital can produce one unit of consumables. The number of units of consumables that a producer actually produces equals the product of the amount of human capital that he has available for production and the fraction of this human capital that he allocates to production. Thus, a well endowed producer produces $(1-e)K/(1+G)$ units of consumables, and a poorly endowed producer produces $k/(1+G)$ units of consumables. With the same value of G for all of the producers, total production equals $[N(1-e)K + nk]/(1+G)$ units of consumables.

Let p denote the fraction of his production that a producer retains. Predators appropriate the fraction $1-p$.[8] To determine p assume that the larger is the ratio of predators to producers the more predators each producer encounters. Also assume that the larger is the ratio of resources allocated to guarding against predators to production that has to be guarded the less success a predator has in each encounter.

These assumptions imply that p depends negatively on R and positively on G. Specifically, assume that

$$(2) \qquad p = \begin{cases} \dfrac{1}{1+\theta R/G} & \text{for } R > 0, \quad \theta > 0 \\ 1 & \text{for } R = 0. \end{cases}$$

In equation (2), the parameter θ, which embodies the technology of predation, determines the effectiveness of predators in appropriating consumables for given values of R and G.[9]

[8]For simplicity we abstract from possible destruction of some consumables as the result of predation. In Grossman and Kim (1995) we show how destruction is easily incorporated into the analysis.

[9]Because well endowed people and poorly endowed people are equally effective at predation, p does not depend on the identity of the predators. With some effort we could extend the model to allow for a negative externality in guarding. For example, it is possible that, if your neighbors build high walls around their properties but you do not build a high wall around your property, then your property becomes a relatively easier target for burglars. In this case, for each producer p would not only depend on his own guarding ratio, but also would be positively related to his own guarding ratio relative to the guarding ratio of other

Let C denote the consumption of a well endowed producer, and let c denote the consumption of a poorly endowed producer. For each producer consumption is the product of p and the units of consumables that he produces. Thus, we have

(3) $$C = \frac{p\,(1-e)K}{1+G}$$

and

(4) $$c = \frac{p\,k}{1+G}.$$

Let D denote the consumption of a predator. Assuming that each predator obtains an equal share of the total amount of consumables appropriated from the producers, we have

(5) $$D = \frac{1-p}{R/(1+R)}\ \frac{N(1-e)K + nk}{1+G}.$$

4. The Choice to be a Producer or a Predator

For ease of exposition we analyze sequentially three decisions — the choice of each person to be a producer or a predator, the choice by producers of the amount of guarding against predators, and the choice by well endowed people of an educational policy. An equilibrium of our model simultaneously reconciles these choices.

To decide whether to be a producer or a predator, each well endowed person compares the values of C and D, both of which he takes as given, and each poorly endowed person compares the values of c and D, both of which he takes as given. Using equations (1) - (5) we find that these comparisons are defined for G not smaller than θ and that they depend on G in the following way:

1. If D equals C but is larger than c, then poorly endowed people prefer to be predators, whereas well endowed people are indifferent between being producers or

producers. With individual choice of the amount of guarding this effect would cause each producer to choose a larger guarding ratio for any given value of R.

predators. This case would occur if and only if G equals θ. In this case, R can take any value larger than or equal to U.

2. If D is smaller than C but larger than c, then poorly endowed people prefer to be predators, whereas well endowed people prefer to be producers. This case could occur only if G is larger than θ, but smaller than $\theta(1-e)K/k$. In this case, R is equal to U.

3. If D is smaller than C but equal to c, then poorly endowed people are indifferent between being producers or predators, whereas well endowed people prefer to be producers. This case could occur only if G is equal to or larger than $\theta\Omega_o/k$, but not larger than $\theta(1-e)K/k$. In this case, the equality between D and c implies that R is equal to $(G-\theta\Omega_o/k)/(\theta\Omega_o/k-\theta)$. This implied value of R is equal to or smaller than U, but larger than or equal to zero.

4. If D is smaller than both c and C, then every person prefers to be a producer. This case could occur only if G is larger than $\theta\Omega_o/k$. In this case, R equals zero.

Summarizing these results we have

$$R = \begin{cases} x \in [U, \infty] & \text{if and only if} \quad G = \theta \\ U & \text{only if} \quad \theta < G < \theta(1-e)K/k \\ \frac{G-\theta\Omega_o/k}{\theta\Omega_o/k-\theta} & \text{only if} \quad \theta\Omega_o/k \leq G \leq \theta(1-e)K/k \\ 0 & \text{only if} \quad G > \theta\Omega_o/k. \end{cases} \tag{6}$$

The next section turns to the choice of G by producers.

5. Unconstrained Collective Choice of Guarding

Consider a country in which limited ability to enforce a collective choice of the amount of guarding against predators, as represented by $\overline{G}$, does not impose a binding constraint. In this country the producers collectively choose G to maximize C and c, as given by equations (3) and (4). This collective choice of G takes into account both the effect of G on p for a given ratio of predators to producers, as given by equation (2), and the effect of G on the choices of well endowed people and poorly endowed people to be predators, as given by equation (6). Because a producer choosing his amount of guarding individually would not take into account the effect of G on R, the unconstrained collective choice of G is as large as or larger than producers would choose individually. Hence, given an unconstrained collective choice of G producers would not individually choose to allocate any additional human capital to guarding.

Substituting equations (2) and (6) into equations (3) and (4), we find that both C and c have a local maximum at G equal to G^*, where

$$G^* = (1+\epsilon)\theta(1-e)K/k, \tag{7}$$

and where ϵ is an arbitrarily small positive number. From equation (6), G^* is the minimum value of G that would result in an equilibrium in which R uniquely equals zero. In other words, G^* is the minimum value of G that would surely deter every person, whether well endowed or poorly endowed, from choosing to be a predator.[10] Equation (7) implies that G^* is negatively related to $k/(1-e)K$. In other words, G^* is larger the less egalitarian is the interpersonal distribution of human capital.

We also find that both C and c can have either one of two other local maxima. One of these possible local maxima is at G equal to $\sqrt{\theta U}$, which is the solution to the first-order conditions for an interior maximum, $dC/dg = dc/dg = 0$, given $R = U$. The other possible local maximum is at G equal to $(1+\epsilon)\theta$, which is the minimum value of G that would deter only all of the well endowed people from choosing to be predators. From equation (7) $(1+\epsilon)\theta$ is also the value that G^* approaches as k approaches $(1-e)K$ — that is, as the interpersonal distribution of human capital becomes more egalitarian.

[10]Equation (6) says that $R = 0$ could also be associated with values of G such that $\theta(1-e)K/k \geq G > \theta\Omega_o/k$. But, such values of G also can be associated with positive values of R.

To determine the global maximum, we compare the values of C and c associated with G equal to G^*, $\sqrt{\theta U}$, and $(1+\epsilon)\theta$. Substituting equations (2) and (6) into equation (3) we find that the values of C that would result from each of these possible choices of G are

$$(8) \qquad C = \begin{cases} \dfrac{(1-e)K}{1+G^*} & \text{for } G = G^* \\[2ex] \dfrac{(1-e)K}{(1+\sqrt{\theta U})^2} & \text{for } G = \sqrt{\theta U} \\[2ex] \dfrac{(1-e)K}{(1+\frac{U}{1+\epsilon})[1+(1+\epsilon)\theta]} & \text{for } G = (1+\epsilon)\theta \end{cases}$$

The values of c that would result from each of these possible choices of G are the same, except that k replaces $(1-e)K$ in the numerator of each expression. Given k and U the producers collectively choose the value of G for which the resulting values of C and c are largest. Denote the resulting value of C as C_J.

6. Educational Policy With Unconstrained Collective Choice of Guarding

In order to analyze the choice of educational policy, we have to specify the initial interpersonal distribution of human capital. Let k_o denote the initial endowment of human capital of an initially poorly endowed person, let K_o denote the initial endowment of human capital of an initially well endowed person, and let U_o denote the ratio of initially poorly endowed people to initially well endowed people. Equation (1) implies that K_o equals $\Omega_o + U_o(\Omega_o - k_o)$.

To make the problem interesting assume that U_o is large and that k_o is small. Specifically, assume that k_o is smaller than $K_o\sqrt{\theta/U_o}$ and that U_o is larger than θ.

Given that the producers collectively choose G to maximize C, with the consequence that C equals C_J, the well endowed people collectively choose an educational policy — that is, a combination of k and U — to maximize C_J, subject to $k \geq k_o$ and $U \leq U_o$. The constraints $k \geq k_o$ and $U \leq U_o$ are consistent with the redistributional component of educational policy being from the well endowed to the initially poorly endowed. Equation (1) implies that, given Ω_o, the choice of k and U also determines $(1-e)K$, the amount of human capital that each well endowed person has available for the production of consumables.

Substituting equation (1) into equation (8) we find that, with U_o larger than θ, the well endowed people choose an egalitarian educational policy that leaves U unchanged and equal to U_o, but that increases k, and decreases $(1-e)K$, to satisfy

$$k = (1-e)K\sqrt{\theta/U_o}. \tag{9}$$

We also find that, given the egalitarian educational policy described by equation (9), the producers collectively choose

$$G = G^*, \tag{10}$$

where, from equations (7) and (9), G^* equals $(1+\epsilon)\sqrt{\theta U_o}$. Mathematical Appendix A provides a derivation of equations (9) and (10).

The choices given by equations (9) and (10) equate C to C_J and also maximize C_J. The intuition is as follows: With $\overline{G}$ not imposing a binding constraint, it is feasible for producers to deter the poorly endowed people from choosing to be predators. Furthermore, with U being large, if the poorly endowed people were not deterred from being predators, then the ratio of predators to producers and the resulting fraction of production lost to predation would be large. Hence, the producers choose enough guarding to deter the poorly endowed people from choosing to be predators, while the well endowed people choose an educational policy that balances the marginal benefit of decreasing the cost of deterring predation, by increasing the human capital of poorly endowed people, with the marginal cost of increasing the human capital of poorly endowed people.

Equations (9) and (10) implicitly assume that every person who is initially poorly endowed with human capital is sufficiently educable to be able to achieve the endowment k

as given by equation (9). But, if some people are not sufficiently educable, then the choice of G as given by equation (10) would not deter everyone from choosing to be a predator. Moreover, as long as the number of people who are not sufficiently educable is small, the producers would not increase the amount of guarding sufficiently to deter these people from choosing to be predators. In this way the analysis can allow for a residual of insufficiently educable predators.

Propositions *[1]* and *[2]* summarize the implications of this analysis.

> *[1] If limited ability to enforce a collective choice of the amount of guarding against predators does not impose a binding constraint, then the well endowed people choose an egalitarian educational policy that increases the human capital of all of the initially poorly endowed people.*
>
> *[2] Given the interpersonal distribution of human capital that results from this educational policy, the producers collectively chose enough guarding against predators to deter every educable person from choosing to be a predator.*

7. Educational Policy With Constrained Collective Choice of Guarding

Consider another country in which limited ability to enforce a collective choice of the amount of guarding against predators, as represented by $\overline{G}$, imposes a binding constraint. Specifically, assume that $\overline{G}$ is smaller than $(1+\epsilon)\sqrt{\theta U_o}$, which is the choice of G derived in the preceding section, but also assume that $\overline{G}$ is at least as large as $(1+\epsilon)\theta$. Recall that $(1+\epsilon)\theta$ is the minimum value of G that would deter all of the well endowed people from choosing to be predators, and that it is also the value that G^* approaches as k approaches $(1-e)K$.

In this country, given k and U, the producers collectively choose the value of G for which the resulting values of C and c, as given by equation (8), are largest, subject to the constraint $G \leq \overline{G}$. Denote the resulting value of C as $\overline{C}_J$. Given that C equals

$\overline{C}_J$, the well endowed people collectively choose k and U to maximize $\overline{C}_J$, subject to $k \geq k_o$ and $U \leq U_o$.

Substituting equation (1) into equation (8) we find that, with U_o larger than θ, the well endowed people choose an egalitarian educational policy that leaves U unchanged and equal to U_o, but increases k, and decreases $(1-e)K$, to satisfy

$$k = (1-e)K(1+\epsilon)\theta/\overline{G}. \tag{11}$$

Combining equations (7) and (11) we see that with this educational policy G^* becomes equal to $\overline{G}$. In other words, the educational policy that the well endowed people choose makes $\overline{G}$ sufficient to deter everyone from choosing to be a predator. We also find that, given the educational policy described by equation (11), the producers take advantage of this opportunity by choosing

$$G = \overline{G} = G^*. \tag{12}$$

Mathematical Appendix B provides a derivation of equations (11) and (12).

Equation (11) implies that educational policy is such that $k/(1-e)K$ is an increasing function of $\overline{G}$. In the limit, as $\overline{G}$ approaches $(1+\epsilon)\theta$, $k/(1-e)K$ approaches one. In this case the educational policy that the well endowed people choose approaches a policy that would equalize the human capital of every educable person.

Propositions *[3]* and *[4]* summarize the implications of this analysis.

> *[3] If limited ability to enforce a collective choice of guarding against predators imposes a binding constraint, but the maximum collectively chosen guarding ratio that can be enforced is at least large enough to deter all of the well endowed people from choosing to be predators, then the well endowed people choose an egalitarian educational policy that increases the human capital of all of the initially poorly endowed people sufficiently to make it possible for producers, by collectively choosing the maximum enforceable guarding ratio, to deter every educable person from*

choosing to be a predator. This educational policy gives more human capital to the poorly endowed people the smaller is the maximum enforceable guarding ratio.

[4] Given this egalitarian educational policy, the producers collectively chose the maximum enforceable guarding ratio, and every educable person is deterred from choosing to be a predator, as in the previous case in which limited ability to enforce a collective choice of guarding was not a binding constraint.

8. The Ratio of Predators to Producers with Individual Choice of Guarding

Finally, consider a country in which $\overline{G}$, the maximum enforceable collective choice of G, is smaller than $(1+\epsilon)\theta$. In this country not only is $\overline{G}$ a binding constraint, but, as we shall see, $\overline{G}$ is not larger than the guarding ratio that producers would choose individually. Hence, in this country the strategic advantage of collective choice of guarding is lost.

In individually choosing the amount of guarding, each producer takes the choices of other people to be producers or predators as given. Thus, if a well endowed person chooses to be a producer, then he chooses G to maximize C, taking R as given, and if a poorly endowed person were to choose to be a producer, then he would choose G to maximize c, taking R as given.

To analyze the individual choice of G we substitute equation (2) into equations (3) and (4) and calculate the value of the ratio G that satisfies the conditions $dC/dG = 0$ and $dc/dG = 0$. For both well endowed producers and poorly endowed producers these conditions imply

$$G = \sqrt{\theta R}. \tag{13}$$

Solving equations (6) and (13) for R, and assuming that the ratio k/Ω_o is small relative to θ, the equilibrium ratio of predators to producers with individual choice of G is

$$R \doteq max\{\theta, U\}. \tag{14}$$

Equation (14) says that, if U is equal to or larger than θ, then all of the poorly endowed people choose to be predators, and all of the well endowed people choose to be producers. Alternatively, if U were smaller than θ, then all of the poorly endowed people and some of the well endowed people would choose to be predators.[11]

Substituting for p from equation (2) and for G and R from equations (13) and (14) into equation (3), we calculate the equilibrium value of C, denoted C_I, to be

$$C_I = \begin{cases} \dfrac{(1-e)K}{(1+\theta)^2} & \text{for } U \leq \theta \\ \\ \dfrac{(1-e)K}{(1+\sqrt{\theta U})^2} & \text{for } U > \theta. \end{cases} \tag{15}$$

Equation (15), together with equation (1), tells us how C_I depends on k and U.

9. Educational Policy With Individual Choice of Guarding

With individual choice of the amount of guarding the well endowed people choose an educational policy — that is, a combination of k and U — to maximize C_I, as given by equation (15), subject to $k \geq k_o$ and $U \leq U_o$. Assume again that U_o is larger than θ.

Substituting equation (1) into equation (15) we find that C_I is a decreasing function of k. This result obtains because increasing k would decrease $(1-e)K$ without affecting R. Thus, part of the solution to the problem of maximizing C_I is for the well endowed people to leave k unchanged and equal to k_o.

[11] More generally, solving equations (6) and (13) for R would yield

$$R = \begin{cases} \theta & \text{for } U \leq \theta \\ U & \text{for } \theta < U \leq R_1 \\ R_1 & \text{for } R_1 < U < R_2 \\ \{R_1, R_2, U\} & \text{for } U \geq R_2, \end{cases}$$

where R_1 and R_2 are the values of R that satisfy both $R = (G - \theta\Omega_o/k)/(\theta\Omega_o/k - \theta)$, from equation (6), and $G = \sqrt{\theta R}$, from equation (13). Such values of R could exist only if k/Ω_o were not small relative to θ.

We also find that, for U smaller than θ, C_I is an increasing function of U. This result obtains because, as R cannot be smaller than θ, making U even smaller that θ would decrease $(1-e)K$ without affecting R.

Finally, we find that, for U larger than θ, C_I is a quasi-convex function of U. Specifically, C_I has a local maximum at U equal to θ, has a local minimum at a value of U that is larger than θ, and approaches a finite limit from below as U goes to infinity. If and only if U equal to θ is not the global maximum, then there exists a value of U, denoted $\hat{U}$, such that C_I evaluated at any value of U larger than $\hat{U}$ is larger than C_I evaluated at U equal to θ. (Note that $\hat{U}$, if it exists, is larger than θ.) Figures 1 and 2 depict the relation between C_I and U on the assumption that $\hat{U}$ exists.

This analysis implies that the solution to the problem of maximizing C_I may or may not call for the well endowed people to use some of their human capital to decrease U. If $\hat{U}$ exists and if U_o is as large as or larger than $\hat{U}$, as illustrated in Figure 1, then the well endowed people leave U unchanged and equal to U_o. In Figure 1 we see that decreasing U from U_o could only decrease C_I. In this case, the well endowed people do not choose to use any of their human capital to educate people who are initially poorly endowed. This result obtains because, with a small fraction of people who are initially well endowed, a given decrease in U would require that a large fraction of the human capital of the well endowed people be used for education.

Alternatively, either if $\hat{U}$ does not exist or if U_o is smaller than $\hat{U}$, as illustrated in Figure 2, then to maximize C_I the well endowed people decrease U to make U equal θ. In Figure 2 we see that U equal to θ would yield the largest value of C_I for all values of U less than or equal to U_o. In this case, the well endowed people choose to educate some of the initially poorly endowed people sufficiently to make them also well endowed, thereby decreasing the fraction of people who are poorly endowed, but leaving the remaining poorly endowed people with no more than their initial endowment of human capital. This elitist educational policy reduces R, the ratio of predators to producers, from U_o to θ. Because of limited ability to enforce a collective choice of the amount of guarding, educational policy is directed towards decreasing the number of predators rather than facilitating the deterrence of predation.

Proposition *[5]* summarizes the implications of this analysis.

[5] If the constraint on the ability to enforce a collective choice of the amount of guarding against predators binds so tightly that it is not feasible, even with an egalitarian educational policy, to deter the poorly endowed people from choosing to be predators, then the well endowed people choose an elitist educational policy. Further, if the ratio of initially poorly endowed people to initially well endowed people is sufficiently large, then this elitist educational policy does not have a redistributional component. Alternatively, if the ratio of initially poorly endowed people to initially well endowed people is not too large, then this elitist educational policy decreases the fraction of people who are poorly endowed, but leaves the remaining poorly endowed people with no more than their initial endowment of human capital.

10. Summary

Assuming that people can choose to be either producers or predators, well endowed people can maximize their own consumption by choosing collectively to use some of their human capital to educate people who, because of modest natural ability or ineffective nurturing or both, are initially poorly endowed with human capital. More interestingly, whether the well endowed people choose an egalitarian educational policy that increases the human capital of all of the poorly endowed people or an elitist educational policy that, if it has a redistributional component, only decreases the number of poorly endowed people without increasing the human capital of the remaining poorly endowed people depends on the ability to enforce a collective choice of the amount of guarding against predators.

We found that there are three possible cases.

1. If limited ability to enforce a collective choice of the amount of guarding does not impose a binding constraint, then the well endowed people maximize their own consumption by choosing an egalitarian educational policy that by increasing the human capital of all of the poorly endowed people decreases the cost of deterring educable people from choosing to be predators. In this case, the amount of human capital that the educational policy gives to the poorly endowed people does not depend on the collectively chosen guarding ratio that producers can enforce.

2. If limited ability to enforce a collective choice of the amount of guarding imposes a binding constraint, but this constraint is not tight enough to negate the strategic advantage of collective choice in taking into account the deterrent effect of guarding on the choice of people to be predators, then the well endowed people maximize their own consumption by choosing an egalitarian educational policy that by increasing the human capital of the poorly endowed people makes it possible to deter educable people from choosing to be predators. In this case, educational policy gives more human capital to the poorly endowed people the smaller is the maximum collectively chosen guarding ratio that producers can enforce.

3. If the ability to enforce a collective choice of the amount of guarding is so limited that the strategic advantage of collective choice is lost, then producers, or small subsets of producers, individually choose the amount of human capital to allocate to guarding. Importantly, an individual producer, or small subset of producers, takes the choices of other people to be either predators or producers as given, ignoring the deterrent effect of guarding on the number of people who choose to be predators. In this case the well endowed people maximize their own consumption by choosing an elitist educational policy that, if it has a redistributional component, decreases the number of poorly endowed people and, thereby, decreases the number of predators.

This analysis implies an interesting discontinuity. At the boundary between the second and third cases a small decrease in the maximum collectively chosen guarding ratio that can be enforced would cause the well endowed people to switch from a egalitarian educational policy that almost equalizes the human capital of every educable person to an elitist policy that can leave many poorly endowed people with little human capital.

Applying this theory, we contrast two sets of countries. One set includes Western European countries and some East Asian countries, like Japan, Korea, Singapore, and Taiwan, that seem to provide examples of largely collective choice of the amount of guarding against predators, and in which, as a result, the amount of guarding has been sufficient to deter most low-skilled predatory activities like burglary, robbery, and kidnaping. Our theory leads us to expect these countries to have egalitarian educational policies that provide even relatively poorly endowed people with a good education. The other set includes countries in South America, Africa, and Asia, including the Philippines, and, perhaps, also the United States, that seem to provide examples in which the amount of guarding against predators mainly depends on individual choice. Our theory leads us to expect these countries to have elitist educational policies that give some people an excellent education and other people little or no effective education. As we have noted, these implications seem to be consistent with the facts about differences across countries in educational policy.

Mathematical Appendices

A. Educational Policy With Unconstrained Collective Choice of Guarding

Let C_J^* denote the global maximum of C_J subject to the constraints $k_o \leq k \leq \Omega_o$ and $0 \leq U \leq U_o$. We find the values of k and U associated with C_J^* by comparing the three possible local maxima, as given by equation (8), each maximized with respect to U and k.

1. Substituting equation (1) into the first row of equation (8), we find that the local maximum for C at $G = G^* = (1+\epsilon)\theta(1-e)K/k$ is maximized with $U = U_o$ and

$$k = \min\{\frac{\sqrt{1+\epsilon}\,(1+U_o)}{U_o + \sqrt{U_o/\theta}}, 1\}\ \Omega_o,$$

or, equivalently, $k/(1-e)K = \min\{\sqrt{\theta/U_o},\ 1\}$. The resulting value of C, denoted C^I, is

$$C^I = \begin{cases} \dfrac{\Omega_o}{1+(1+\epsilon)\theta} & \text{for } U_o \leq \theta \\ \\ \dfrac{\Omega_o(1+U_o)}{(1+\sqrt{\theta U_o})[1+\sqrt{(1+\epsilon)\theta U_o}]} & \text{for } U_o > \theta. \end{cases}$$

2. Substituting equation (1) into the second row of equation (8), we find that the local maximum of C at $G = \sqrt{\theta U}$, if it exists, is maximized either with $U = (1+\epsilon)\theta$ and $k = k_o$ or with $U = U_o$ and $k = k_o$. The resulting value of C, denoted C^{II}, is either

$$C^{II} = \frac{[1+(1+\epsilon)\theta]\Omega_o - (1+\epsilon)\theta k_o}{(1+\theta\sqrt{1+\epsilon})^2} \quad \text{with } U = (1+\epsilon)\theta \text{ and } k = k_o$$

or

$$C^{II} = \frac{(1+U_o)\Omega_o - U_o k_o}{(1+\sqrt{\theta U_o})^2} \quad \text{with } U = U_o \text{ and } k = k_o.$$

3. Substituting equation (1) into the third row of equation (8), we find that the local maximum of C at $G = (1+\epsilon)\theta$, if it exists, is maximized with $U = 0$. The resulting maximized value of C, denoted C^{III}, is $C^{III} = \Omega_o/[1+(1+\epsilon)\theta]$.

We can easily see that, if $U_o > \theta$, then $C^I > C^{II}$ and $C^I > C^{III}$, regardless of whether C^{II} occurs with $U = (1+\epsilon)\theta$ or $U = U_o$. Thus, C_J^* is associated with $U = U_o$ and with k and G as given by equations (9) and (10).

B. Educational Policy With Constrained Collective Choice of Guarding

Let $\overline{C}_J^*$ denote the global maximum of C_J subject to the constraint $G \leq \overline{G}$ and subject to the constraints $k_o \leq k \leq \Omega_o$, and $0 \leq U \leq U_o$. Assume that $U_o > \theta$ and $(1+\epsilon)\theta \leq \overline{G} < (1+\epsilon)\sqrt{\theta U_o}$. Again, we find the values of k and U associated with $\overline{C}_J$ by comparing the three possible local maxima, as given by equation (8), each maximized with respect to U and k.

1. Although the value of G associated with the maximization of the first row of equation (8) with respect to U, k, and G does not satisfy the constraint $G \leq \overline{G}$, by substituting equation (1) into $G = (1+\epsilon)\theta(1-e)K/k$ and rewriting the constraint $G \leq \overline{G}$ as $(1+\epsilon)\theta[\Omega_o + U(\Omega_o - k)]/k \leq \overline{G}$, we see that the binding constraint of $\overline{G}$ can be satisfied at $G = (1+\epsilon)\theta(1-e)K/k$ either by decreasing U or by increasing k. Because both decreasing U and increasing k reduces the value of C at $G = (1+\epsilon)\theta(1-e)K/k$ from the unconstrained maximum, the constrained maximum would occur with the constraint $G \leq \overline{G}$ satisfied as an equality. Substituting $G = \overline{G} = (1+\epsilon)\theta(1-e)K/k$ into the first row of equation (8), we find that, with the constraint $G \leq \overline{G}$ satisfied as an equality, the local maximum for C at $G = (1+\epsilon)\theta(1-e)K/k$ is $C = k\overline{G}/(1+\epsilon)\theta(1+\overline{G})$. This local maximum for C is maximized with the largest value of k that satisfies the constraints $U \leq U_o$, $k \leq \Omega_o$, and $G = \overline{G}$. Thus, this local maximum for C is maximized with $U = U_o$ and

$$k = \frac{(1+\epsilon)\theta(1+U_o)\Omega_o}{(1+\epsilon)\theta U_o + \overline{G}},$$

or, equivalently, $k = (1-e)K(1+\epsilon)\theta/\overline{G} > \sqrt{\theta/U_o}$. The resulting value of C, denoted $\overline{C}^I$, is

$$\overline{C}^I = \frac{\overline{G}(1+U_o)\Omega_o}{(1+\overline{G})[(1+\epsilon)\theta U_o + \overline{G}]}.$$

2. Similarly, although $G = \sqrt{\theta U_o}$ does not satisfy the constraint $G \leq \overline{G}$, this constraint can be satisfied by decreasing U. In this case, because decreasing U decreases the value of C at $G = \sqrt{\theta U}$ from the unconstrained maximum, the constrained maximum would occur with the constraint $G \leq \overline{G}$ satisfied as an equality. The value of G associated with $U = (1+\epsilon)\theta$ satisfies the constraint $G \leq \overline{G}$. Substituting $G = \overline{G} = \sqrt{\theta U}$ and equation (1) into the second row of equation (8), we find that, with the constraint $G \leq \overline{G}$ satisfied as an equality, the local maximum for C at $G = \sqrt{\theta U}$ is maximized either with $U = (1+\epsilon)\theta$ and $k = k_o$ or with $U = \overline{G}^2/\theta$ and $k = k_o$. The resulting value of C, denoted $\overline{C}^{II}$, is either

$$\overline{C}^{II} = \frac{[1+(1+\epsilon)\theta]\Omega_o - (1+\epsilon)\theta k_o}{(1+\theta\sqrt{1+\epsilon})^2} \quad \text{with } U = (1+\epsilon)\theta \text{ and } k = k_o$$

or

$$\overline{C}^{II} = \frac{(1+\overline{G}^2/\theta)\Omega_o - \overline{G}^2 k_o/\theta}{(1+\overline{G})^2} \quad \text{with } U = \overline{G}^2/\theta \text{ and } k = k_o.$$

3. The constraint $G \leq \overline{G}$ is not binding for the maximization of the local maximum for C at $G = (1+\epsilon)\theta$. As in the previous section, the local maximum for C at $G = (1+\epsilon)\theta$, if it exists, is maximized with $U = 0$ and $C^{III} = \Omega_o/[1+(1+\epsilon)\theta]$.

We can easily confirm that $\overline{C}^{I} > \overline{C}^{II}$ and $\overline{C}^{I} > C^{III}$, regardless of whether $\overline{C}^{II}$ occurs with $U = (1+\epsilon)\theta$ or $U = \overline{G}^2/\theta$. Thus, $\overline{C}^*_J$ is associated with $U = U_o$ and k and G as given by equations (11) and (12).

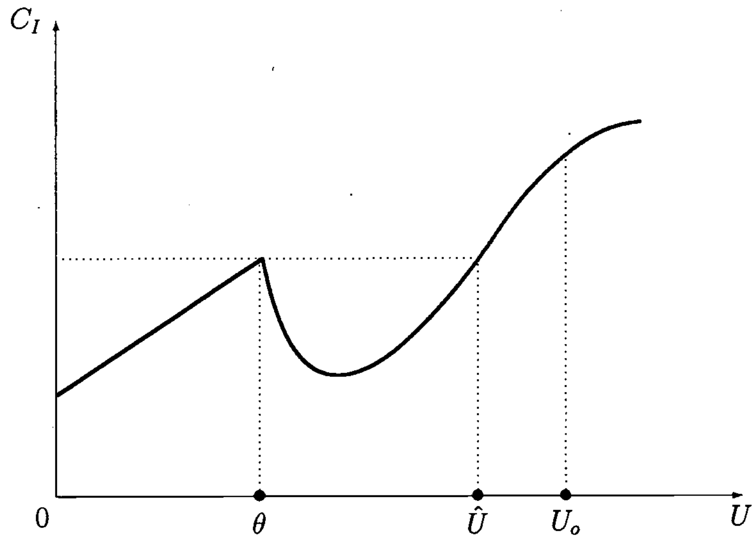

Figure 1: $U_o > \hat{U}$

Elitist Educational Policy Without Redistributional Component

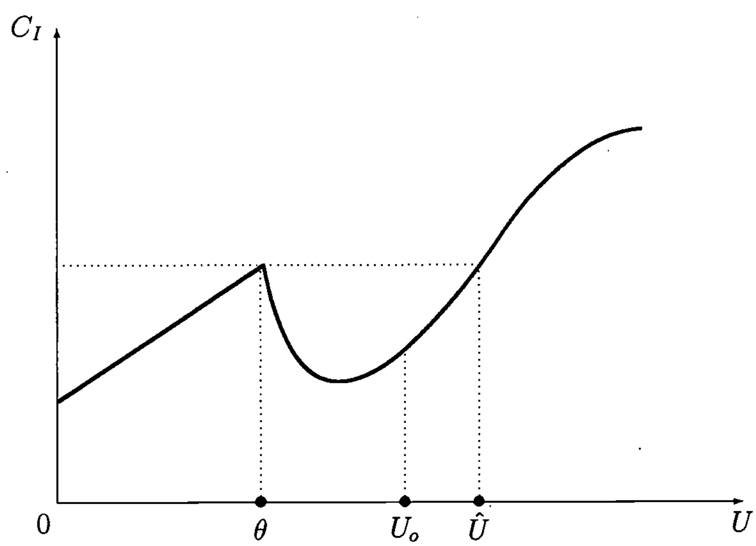

Figure 2: $U_o < \hat{U}$

Elitist Educational Policy With Redistributional Component

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