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Education as a Deterrent to Crime

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Abstract

Most people believe that education - especially elementary education - conveys a civic externality. Students are taught, not only to be productive, but to be honest, upright, law abiding and loyal to their country. Education conveys benefits to society as a whole, over and above the benefit to the student in enhancing his future earning power.

The civic externality is incorporated into an "anarchy" model. People can choose to be farmers or bandits, utilities in these occupations must be equal in equilibrium and education reduces the incidence of banditry by inculcating a distaste for a life of crime. The model serves to clarify the civic externality by removing many other features of the market for education. It shows how the civic externality can place a wedge between private and social returns to education, causing the usual estimates of the return to education to be much too low. It also shows that the presence or absence of a civic externality may depend on how education is provided, in particular, that universality may be critical. This consideration speaks for public as against private education, even with a voucher system, but the civic externality must be weighed against other externalities to education in any assessment of the merits of alternative educational arrangements.

"The Legislation ought nevertheless to pay particular attention to youth, that season of lively and durable impressions, in order to direct the course of the inclinations towards those tastes most conformable to the public interest."

Jeremy Bentham
Principles of the Penal Code
Chapter XX

Education promotes good-citizenship. It is commonly, almost universally, believed that education does more than teach skills to enhance one's capacity to earn income. Education also perpetuates the values of society, enculturates people to serve their communities and promotes the virtues of hard work and honesty. If so, education is the purveyor of a massive civic externality, a social benefit not reflected in the private return to the immediate beneficiary. Yet virtually all of the literature about the return to education is focused upon the comparison between the cost of schooling and the effect of schooling in augmenting the future earnings of the student, ignoring enculturation altogether as though good citizenship were irrelevant and the behavioural externality could be safely ignored. A review of the estimates of the return to education by Psacharopoulos [1985] contains no reference to any paper in which the effect of education on the incidence of crime is incorporated as part of the return. Haveman and Wolfe [1984] recognize crime-reduction as one of twenty non-market effects of schooling, and they cite Erlich [1975] as presenting empirical evidence on the direction of the effect, but they assert that there are no estimates of the return to education associated with reduction of the incidence of crime. Recently Lott has compared public education and private education in their effects on juvenile delinquency (1987) and on what he calls indoctrination (1990), but he does not recompute rates of return to education.

In modelling education as a deterrent to crime, the primary purpose of this paper is explain, in principle, how to take account of the incidence of

crime in the measurement of the return to education. An important secondary purpose is to highlight aspects of the relation between crime and education that may not be immediately obvious. Education may or may not be a deterrent to crime depending on the circumstances in which education is provided. Whether, and in what circumstances, education is a deterrent to crime has a substantial bearing on the desirability of the voucher system as a supplement or substitute for public provision of education.

The natural first step in analysing the economic impact of the inculcation of good behaviour through education is to construct a model in which people may choose to behave badly. One must specify the meaning of bad behaviour before one can say what the effect of education on such behaviour might be. The procedure adopted here is to consider extremes. I postulate a society in which people may choose to be farmers or bandits, where farming is representative of all kinds of good, productive behaviour and banditry is representative of all kinds of bad, wasteful behaviour. The advantage of this procedure is that the cost of banditry and the externality when education reduces the incidence of banditry are immediately evident, so that benefits of education in the promotion of skills and in the promotion of honesty may be compared on a common scale.

The story is told in stages. First, the social cost of banditry is examined in a simple general equilibrium model of occupational choice between farming and banditry. Then education is introduced, but limited to augmenting the marginal product of labour as is assumed in most estimates of the return to education. Then, as a intermediate step to the examination of education as a deterrent to crime, the model is expanded to allow for the deterrence of banditry by punishment. With this analysis in place, the model is expanded once again to endow education with a two-fold effect upon the economy: It influences the productivity of labour in farming <u>and</u> it influences the

relative attractiveness of the life of the bandit as compared with the life of the farmer, where the latter is representative of the impact of education on good citizenship and good behaviour. In this model, everybody is assumed to be like everybody else in his tastes and abilities, and education is universal. An odd feature of the model is that, though the effect of education on the acquisition of skills is more or less the same regardless of who, or how large a proportion of the population, is educated, the effect of education as a deterrent to crime depends critically on the number and identity of the recipients. Finally, uniformity of taste as between farming and banditry is replaced by the assumption that people differ in this regard, and some arguments for and against public provision of education are examined in the light of the models of education that will have been developed.

A: An Equilibrium of Banditry

Consider a society with farming and banditry. Everyone in this society is assumed to be like everyone else in his abilities and his tastes, and each person must choose to become a farmer or a bandit. Naturally, each person chooses the occupation yielding him the higher consumption, so that, in equilibrium, consumption in the two occupations is the same. The core of the model is a postulated technology of skulduggery, a relation between the number of bandits and the amount of the crop they succeed in appropriating. The proportion of total output appropriated by the bandits is assumed to be a concave function of the proportion of bandits in the economy. The purpose of the model is to prepare the ground for the examination of the effects of education on the incidence of banditry and the recognition of these effects into measures of the return to education. The model itself has a strong family resemblance to the standard model of "anarchy" as developed by Bush and Meyer [1974] and extended by Skogh and Stuart [1982].

These are the variables:

n is the proportion of bandits in the population: $0 < n < 1$,

p is the proportion of total output stolen: $0 < p < 1$,

w is the farmers' wage which, for the present, is assumed to be invariant,

c^f is consumption per head of farmers, and

c^b is consumption per head of the bandits.

There are four primary equations in the model of which the first two are definitional.

$$c^f = w(1-p) \tag{1}$$

$$c^b = wp(1-n)/n \tag{2}$$

Consumption per farmer is his productivity of labour scaled down by the proportion, (1-p), not appropriated by bandits. Consumption per bandit is the amount taken from each farmer, wp, times the ratio, (1-n)/n, of the number of farmers to the number of bandits. The third equation depicts the equilibrium in the labour market,

$$c^f = c^b \tag{3}$$

The fourth and final equation shows the technology of skulduggery

$$p = S(n) \qquad \text{where } S' > 0 \text{ and } S'' < 0 \tag{4}$$

This equation is intended to summarize a complex process in which bandits seek to take from farmers and farmers seek to defend themselves. The signs of the derivatives mean that the amount taken per farmer increases with the proportion of bandits in the labour force, but at a decreasing rate. Equation (4) sweeps a great deal under the rug, not all of which will be identified in this paper. Later on, these four equations will be modified to account for education and deterrence. Different versions will be identified by the letters in the titles of the sections where they appear.

Since w is assumed to be constant, this is a system of four equations and four unknowns, p, n, c^f and c^b, to which there would normally be a unique

solution. Notice that, together, equations (1), (2) and (3) imply that $n = p$. However, when we come to incorporate education, it will be simpler to manipulate variables which I call $\hat{p}$ and $\hat{n}$ where $\hat{p} \equiv p/(1-p)$ and $\hat{n} \equiv n/(1-n)$. The equality between n and p becomes

$$\hat{p} = \hat{n}. \tag{5}$$

In principle, equation (4) can be transformed into these variables, so that it becomes $\hat{p} = \hat{S}(\hat{n})$.

Together, equations (4) and (5) determine the equilibrium values of $\hat{p}$ and $\hat{n}$. When the technology of skulduggery is given the specific functional form

$$\hat{p} = (1/2)\hat{n}^{1/2} \tag{4A}$$

it follows at once from equations (4A) and (5) that $\hat{p} = \hat{n} = 1/4$, so that $p = n = 1/5$ and $c^f = c^b = 4w/5$. In equilibrium, 80% of the population are farmers, 20% are bandits and everybody - farmers and bandits alike - is 20% worse off than he would be if banditry could be eliminated costlessly. Banditry is advantageous to the bandit, but, like any negative externality, disadvantageous to society as a whole.

Some interesting features of the model come to light when the circumstances of farmers and bandits are compared in disequilibrium with alternative numbers of bandits. Drop equation (3) and allow c^f to differ from c^b as n varies above or below its equilibrium value. For seven values of n in the neighbourhood of the equilibrium, for $w = 10$ and with the technology of skulduggery in equation (4A), the values of all the variables in the model are presented in table 1. The table illustrates that, as the proportion of bandits in the population increases from 0 to 35%, there is a decline in the consumption of <u>both</u> farmers and bandits, but the consumption of bandits declines more rapidly than the consumption of farmers, guaranteeing that the equilibrium, if there is one, is stable. The equilibrium is, of course,

where the incidence of banditry is 20% and $c^f = c^b = 8$. With fewer bandits - say 15% -, the consumption per bandit (9.49) would exceed the consumption per farmer (8.33), and some farmers would turn to banditry. With more bandits - say 25% -, the consumption per farmer (7.76) would exceed the consumption per bandit (6.73), and some bandits would turn to farming. That is why the equilibrium is stable at n = .2. In general, there may not be an interior equilibrium at all. With a different choice of the technology of skulduggery, the consumption of the farmers might be greater than the consumption of bandits for <u>all</u> values of n, in which case there would be no banditry, or the consumption of bandits might be greater than the consumption of farmers for all values of n, in which case there would be no farming and the society would dissolve into chaos.

Table 1: Consumption Dependent on the Incidence of Banditry

n	$\hat{n}$	$\hat{p}$	p	c^f	c^b
0.0	0.0	0.0	0.0	10.0	
.1	.111	.167	.143	8.57	13.24
.15	.176	.201	.167	8.33	9.489
.2	.25	.25	.2	8.0	8.0
.25	.333	.289	.244	7.76	6.73
.3	.429	.327	.246	7.54	5.73
.35	.538	.367	.268	7.30	4.98

Note: Values of n are postulated; $\hat{n} = n/(1-n)$; $\hat{p}$ is derived from equation (4A); $p = \hat{p}/(1+\hat{p})$; c^f is calculated from equation (1); c^b is calculated from equation (2).

Two diagrams illustrate different facets of the equilibrium. Both are drawn to be consistent with Table 1, but the shapes of the curves in the diagrams are not really dependent on the numerical example. The first shows how consumption in the two occupations varies with the number of bandits.

This is illustrated on figure 1 with the proportion of bandits, n not $\hat{n}$, on the horizontal axis and consumption on the vertical axis. Two curves are shown: the consumption-of-the-farmer curve connecting n and c^f, and the consumption- of-the-bandit curve connecting n and c^b. The labour market is in equilibrium where the two curves cross. Both curves are downward sloping because an increase in the proportion of bandits in the population makes everybody worse off, but the consumption-of-the-bandit curve is steeper and cuts the consumption-of-the-farmer curve from above at the equilibrium.

The other diagram shows the equilibrium as determined by equations (4A) and (5). In figure 2, the variable $\hat{n}$ is on the horizontal axis and the variable $\hat{p}$ is on the vertical axis. The equilibrium condition in equation (5) - $\hat{n} = \hat{p}$ - is represented by a straight line through the origin at 45 degrees to the horizontal axis, and the technology of skulduggery in equation (4A) - $\hat{p} = (1/2)\hat{n}^{1/2}$ - is represented by a concave curve through the origin, cutting the other curve from above at the equilibrium. As neither equation (4A) nor equation (5) depends on w, a spontaneous or education-induced increase in w can have no effect upon the incidence of banditry. This follows from the implicit assumption in the postulated technology of skulduggery that the proportion (as distinct from the amount) of the crop taken by bandits depends on the proportion of bandits in the population. A different assumption could easily allow the incidence of banditry to be affected by the size of the wage.

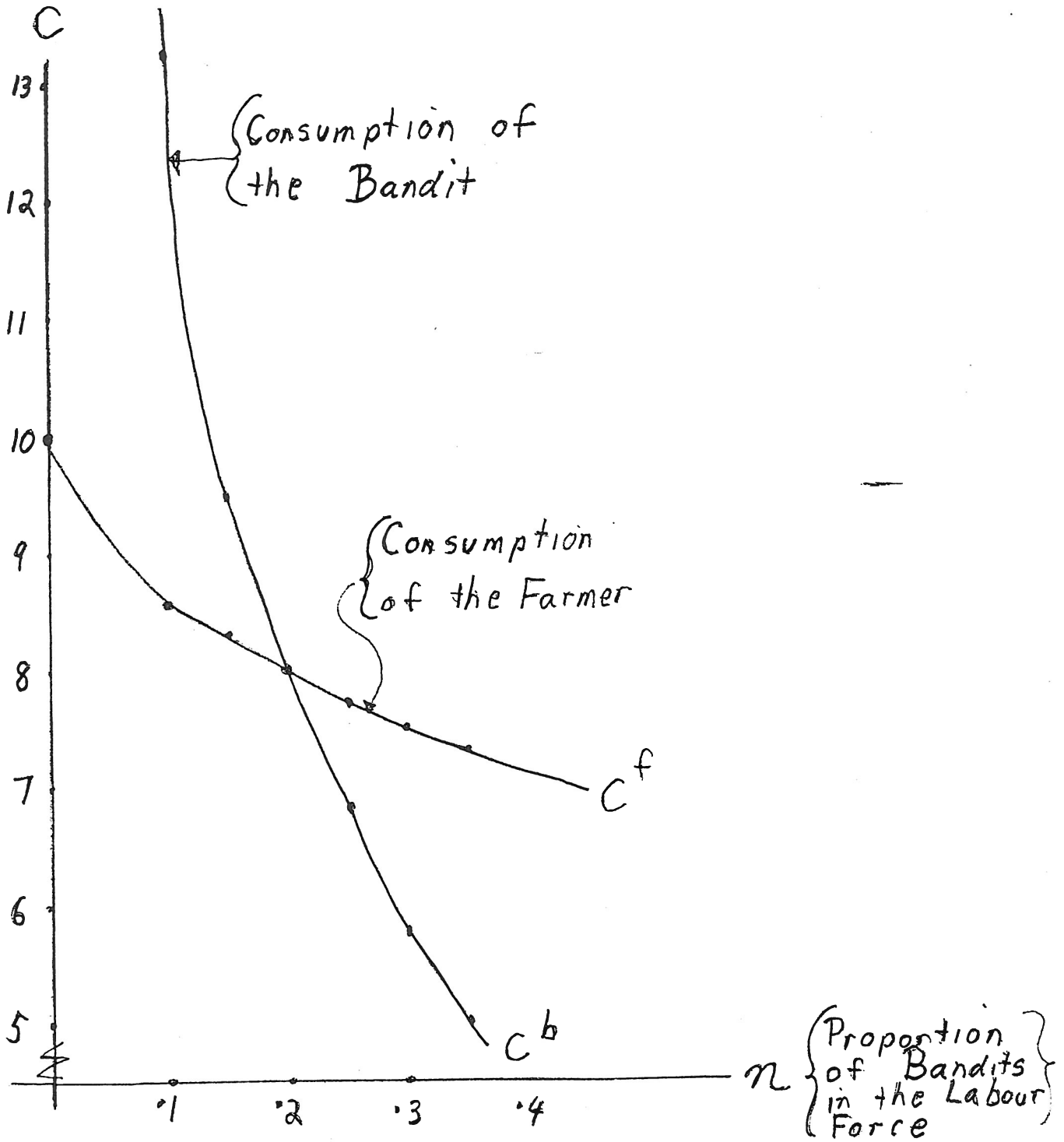

Figure 1: Equilibrium in the Labour Market

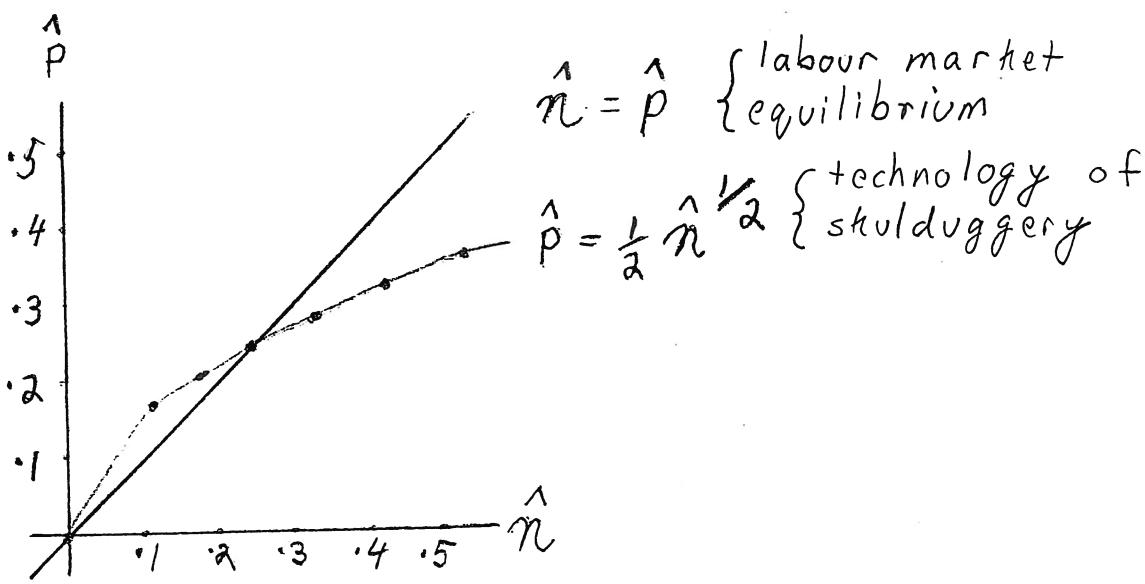

Figure 2: An Alternative Illustration of Equilibrium in the Labour Market

B: Education and the Productivity of Labour

One normally thinks of education as increasing the productivity of labour. This can be represented in this model by converting w from a constant to a function of the amount of education per head. Of course, education is in reality an investment; one educates oneself today to earn more tomorrow. The investment aspect of education is suppressed in this paper. For simplicity, education and its return are assumed to be simultaneous. Let e be the proportion of potential consumption that is spent on education, and let the wage, w, be an increasing function of e.

$$w = w(e) \qquad w' > 0 \text{ and } w'' < 0 \tag{6}$$

Think of each person as endowed with a certain amount of labour and of the government as appropriating a fraction e of that amount (from those who will turn out to be bandits as well as from those who will turn out to be farmers) to pay for education. If the increase in the productivity of labour, as reflected in w(e), were the only effect of education, then education would have no influence upon the incidence of banditry. This is assumed here to be so, not because the assumption is realistic, but because it is especially efficacious in differentiating the impact of education on productivity from its impact on crime. Consumption of farmers and bandits are as indicated in equations (1B) and (2B),

$$c^f = w(e)(1-e)(1-p) \tag{1B}$$

$$c^b = w(e)(1-e)p(1-n)/n \tag{2B}$$

Equations (3) and (4) remain unchanged.

It follows at once that the equilibrium values of p and n are independent of w and that the socially-optimal amount of education can be determined with reference to equation (1B) alone. Consumption of the bandit can be ignored in this formulation, not because of moral considerations as when earnings of burglars and prostitutes are ignored in the official

national accounts, but because equilibrium in the market for labour ensures that consumption is the same in the two occupations; there can be no increase in the consumption of the farmer in equilibrium without an increase in the consumption of the bandit as well. The optimal e is identified by the usual first order condition, $\frac{dc^f}{de} = 0$. Converting derivatives to first differences, the condition for optimality becomes

$$\Delta w(1-e) = w\Delta e \qquad (7)$$

The meaning of equation (7) is that the share of total income devoted to education is optimal when the marginal benefit of education (the left-hand side) is just equal to the marginal cost (the right-hand side). Note that the usual estimates of the return to education are based upon a comparison of marginal cost and marginal benefit as interpreted here, though, of course, in a far more realistic description of the market for education. Suppose, for example, that the effect of education on the productivity of labour were

$$w(e) = 10\ (1 + 2e^{.5} - 3e) \qquad (8)$$

so that, with no expenditure on education and with twenty percent of the population engaged in banditry, the consumption per head would be 8 as before. A little manipulation shows that the optimal, consumption-maximizing expenditure on education is about five percent of gross income, i.e. e = .05, at which consumption per head rises from 8 to 9.9.

When education is incorporated in this way into our simple model of farmers and bandits, there is an effect upon the heights of the curves in figure 1, but the equilibrium value of n remains the same, and there is no effect on either of the curves in figure 2. The equilibrium values of $\hat{p}$ and $\hat{n}$ are exactly as they were in the model with no education at all.

Note that education might be beneficial to bandits as well as farmers, without enhancing the skill of the bandit at all. Farmers benefit directly from the increase in productivity. Bandits benefit by acquiring a fixed

slice, p, of a larger pie. If a person had to provide education for himself, his marginal cost of education would would remain at $w\Delta e$ but his marginal benefit would be reduced to from $\Delta w(1-e)$ to $\Delta w(1-e)(1-p)$ because part of the return to education accrues to bandits who share the increase in the productivity of the farmer. If p is large and if education is in the private sector, there can emerge a "culture of poverty" in which people are not inclined to educate themselves, though the social return to education may be substantial.

C: Punishment

The essence of punishment is that law-abiding folk harm themselves in order to harm criminals more. Punishment is universally-beneficial, not just when crime is eliminated altogether, but when the incidence of crime is reduced enough to compensate for the cost of punishment. A clear line may be drawn between punishment and restitution. With costless restitution, the injured party is "made whole" and full Pareto optimality is attained, as though there were no misbehaviour at all. Punishment is required when restitution is costly, incomplete or impossible because detection of crime is expensive, some criminals escape detection or the injury cannot be made whole as, for instance, when there is a loss of life.

Though some element of punishment may be implicit in the technology of skulduggery in equation (4), it is useful to isolate collectively imposed punishment as a step in the analysis of the deterrent effect of education to be discussed in the next section. The farmers and bandits model is easily adapted to illustrate the mechanics of punishment. As we are not concerned in this paper with the trade-off between the probability of detection and the severity of punishment, it is sufficient to suppose that the government taxes away a proportion of the farmer's income to finance the detection and

punishment of crime, and that the net take of the bandits is reduced to a fraction R(r) of what it would be in the absence of collectively imposed punishment. Thus, $R(0) = 1$, $R' < 0$ and $R'' > 0$. Think of r as the cost per head of detection and punishment by the criminal justice system, net of the value of the loot that is recovered when crime is detected, and think of R(r) as reflecting the loss of the loot, the cost of evasive action to avoid detection and the cost of punishment to the punished rather than to the punisher. By contrast, one might suppose that the value of p is determined within individual encounters between bandits seeking loot and farmers protecting what they have. More realistic assumptions about crime and punishment could be designed, but these will do for our purposes.

The farmers and bandits model becomes

$$c^f = w(1-p)(1-r) \qquad (1C)$$

$$c^b = R(r)wp(1-n)/n \qquad (2C)$$

$$c^f = c^b \qquad (3)$$

$$p = S(n) \qquad (4)$$

where p is the proportion of w(1-r) that is stolen, r is the proportion of farmers' income spent collectively on detection and punishment of bandits, and R is the remaining fraction of the income of bandits.

Obviously 1-r must exceed R over a range between 0 and some $\tilde{r}$ if punishment is to be effective at all, for otherwise c^f and c^b would both be reduced without lowering the equilibrium value of n. Note that the punishment of bandits is modelled here as a "shared good" which is like a public good in that the benefits accrue equally to all, but is unlike a public good in that the total cost of any given benefit per head increases directly with the number of beneficiaries.

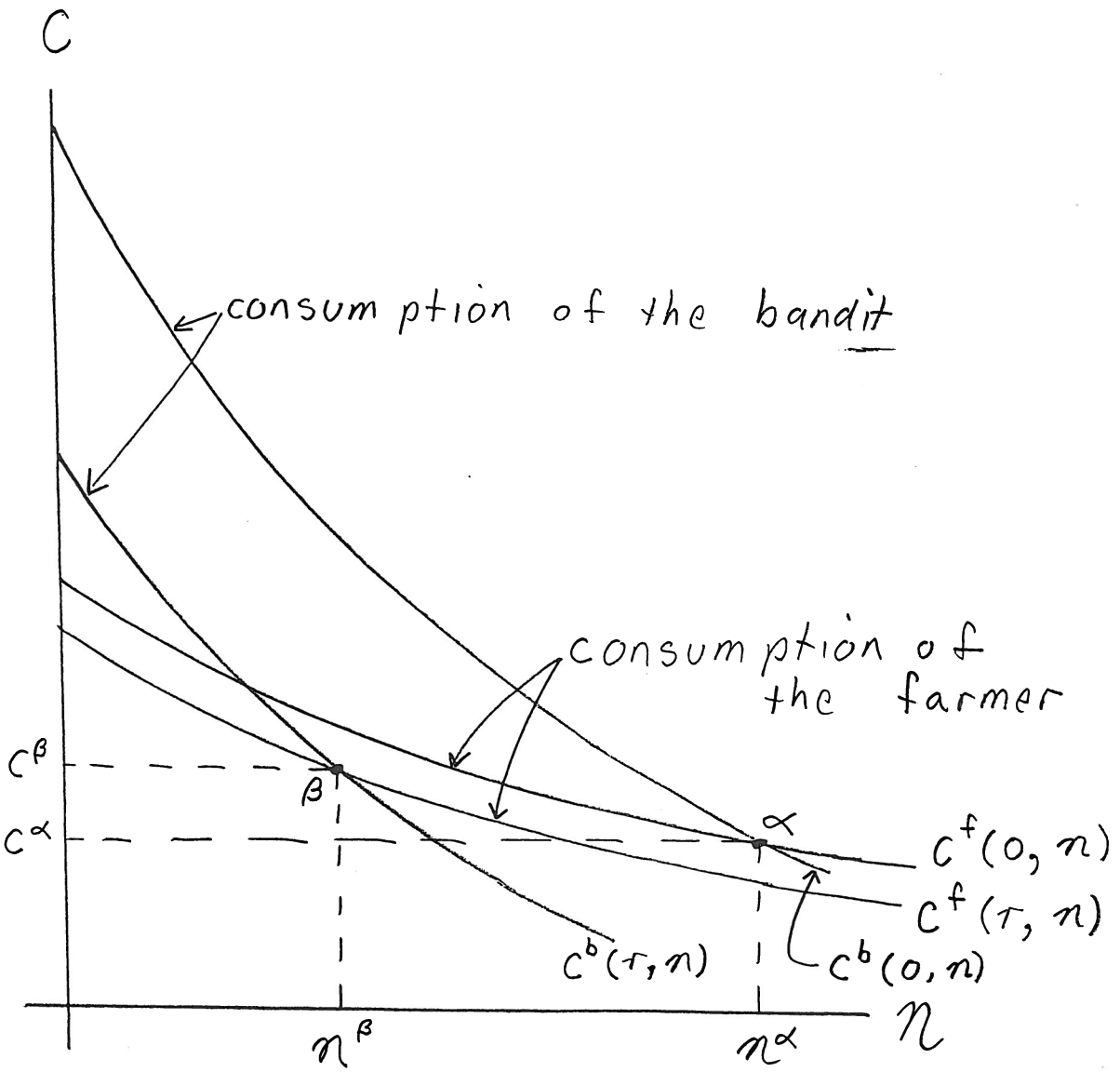

Figure 3: Punishment and the Incidence of Banditry

The effects of punishment are illustrated in figure 3 which is an extension of figure 1 above. When punishment works as intended, the consumption-of-the-farmer curve and the consumption-of-the-bandit curve are both lowered, making everybody, bandits and farmers alike, worse off for any given incidence of banditry, n, but, at the same time, making everybody better off in the new equilibrium with the lower incidence of banditry. In the figure, the original equilibrium, with r equal to 0, is indicated by the point α, and the new equilibrium, for some appropriate positive value of r, is indicated by the point β. As the figure is drawn, the fall in the consumption-of-the-bandit curve is greater than the fall in the consumption-of-the-farmer curve so that the equilibrium n is reduced from n^{α} to n^{β} and the common equilibrium value of c^f and c^b is larger at β than at α.

Consider a specific example: Suppose the function R is

$$R(r) = 1-.5(r)^{.1} \qquad (9)$$

so that R decreases steadily from 1 to .5 as r increases over its permissible range from 0 to 1, but the decrease is initially rapid and rather slow later on. On this assumption, R is reduced to .685 when r is as little as .01, even though R can never fall below one half. When equation (4) takes the specific form (4B), when w = 10 and when r is set at .01, the effect of punishment is to increase the common value of c^f and c^b from 8, as indicated in table 1, to 9.2 because the incidence of banditry is reduced from 20% to 2%.

D: Education and the Utility of Banditry

To speak of education as promoting good citizenship, hard work and a general disinclination by the citizen to engage in crime, is to say, within the context of the model of farmers and bandits, that a person's utility for any given amount of consumption is dependent on whether he is a farmer or a

bandit. Up to this point, it has been assumed that consumption is an adequate surrogate for utility. Now it is assumed instead that people maximize utility rather than consumption, that the utility corresponding to any given amount of consumption may depend on whether one is a farmer or a bandit and that education diminishes the utility of the bandit for any given amount of consumption. Education increases the productivity of labour <u>and</u> inculcates a preference for the life of an honest farmer as compared with the life of a bandit. Educated men may still turn to banditry if the material advantages are substantial, but they prefer to be farmers when the gap between the incomes in the two occupations is small.

Since all that matters here is the ratio of utilities in the two occupations, there is no harm in retaining the assumption that the farmer's utility and the farmer's consumption are the same, as long as the utility of the bandit is set at some fraction of his consumption dependent on the level of education. Thus equation (1) can remain as it was in section B, but equation (2) has to be modified to allow the utility of the bandit associated with any given amount of consumption to depend, in the first instance, upon his taste for a life of crime and, ultimately, upon the amount of education as a determinant of his taste for a life of crime. This effect of education on the welfare of the bandit is captured by the function E(e) in equation (2). The value of E(e) is the ratio of c^f and c^b at which a person with education e is indifferent between farming and banditry. It is assumed that i) $E(0) = 1$ signifying that a person with no education is indifferent between farming and banditry when remuneration is the same, ii) $E(e) < 1$ whenever $e > 0$ signifying that, with equal remuneration, an educated person prefers farming to banditry and iii) $E'(e) < 0$ signifying that additional education widens the gap between the consumption of the farmer and the consumption of the bandit at which one is indifferent between these occupations when

remuneration is the same.

When education is a source of human capital <u>and</u> a deterrent to crime, an increase in e raises w and lowers E simultaneously, so that the model of farmers and bandits becomes

$$u^f = c^f = w(e)(1-e)(1-p) \tag{1D}$$

$$u^b = E(e)w(e)(1-e)p(1-n)/n \tag{2D}$$

$$u^f = u^b \tag{3D}$$

and $\hat{p} = .5\hat{n}^{.5}$ (4D)

The technology of skulduggery in equation (4) remains unchanged from the earlier versions of the model; equation (4D) is the same as equation (4A). Equation (5) becomes

$$E(e)\hat{p} = \hat{n} \tag{5D}$$

The effect of education on the common utility in the two occupations could be illustrated in a diagram like that in figure 3, except that consumption would have to be replaced by utility and the shifts in the curves need not be downward because e, unlike r in equation (1C), has two opposing effects on c^f in equation (1D). Once again, the incidence of banditry would decline, for the utility-of-the-bandit curves would fall more, or rise less, than the utility-of-the-farmer curve. The story is told more straightforwardly in figure 4 which is a variant of figure 2 with no change in the technology of skulduggery in equation (4), but with a counter-clockwise swing of the upward sloping straight line representing equation (5) in response to an increase in E. The original equilibrium for e = 0 and E = 1 is denoted by α. The new equilibrium with a larger e and a correspondingly smaller E is denoted by β. The new equilibrium is necessarily characterized by smaller values of both $\hat{n}$ and $\hat{p}$.

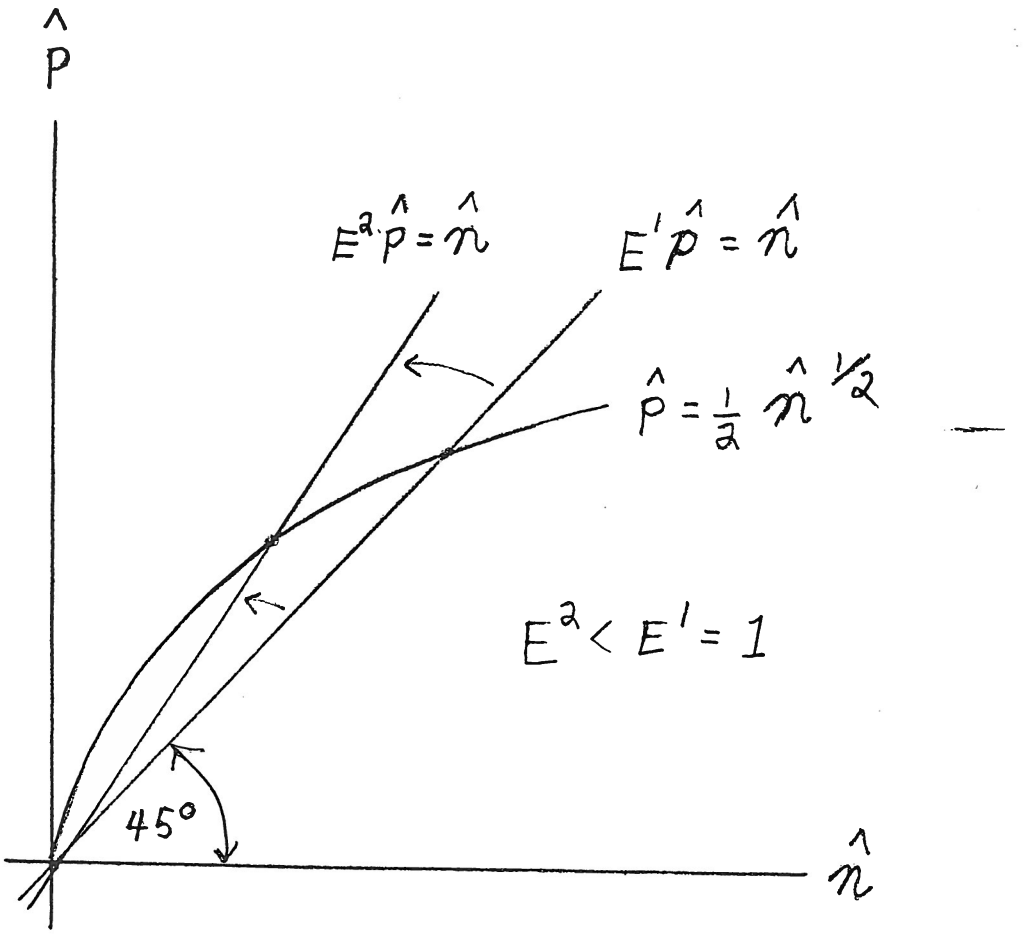

Figure 4: Education and the Incidence of Banditry

From equations (1D), (2D), (3D) and (4A), the equilibrium values of $\hat{n}$ and $\hat{p}$ can be represented as functions of E.

$$\hat{p} = E/4 \tag{10}$$

and $$\hat{n} = E^2/4. \tag{11}$$

If, in addition, the effect of education on the utility of bandits is

$$E(e) = 1 - e^{1/2} \tag{12}$$

then all of the variables in the model may be expressed as functions of e, and the optimal e, at which the common value of u^f and u^b is maximized, can be observed. For values of e between 0 and .1, this information is presented in the top half of table 2. One can see at a glance that the optimal amount of education - that which maximizes the common utility of farmers and bandits - is about 7% of national income as compared with 5% with the same effect of education upon the productivity of labour but no effect upon the desirability of a life of banditry. If that amount of education is provided, the proportion of bandits in the economy is reduced from 20% to a little over 13%, and consumption per head rises to 10.37, as compared with 8 in the absence of education and 9.9 when the only effect of education is to increase the productivity of labour. Obviously, the numbers themselves can have no practical significance, as they are pulled out of thin air. At best, they suggest that the effect on the national income of education as a deterrent to crime may not be altogether negligible by comparison with the effect of education on productivity.

Table 2: The Return to Education

i) The Effect of Education on Utility where u is the Common Value of u^f and u^b

e	E	w	p	n	u
0	1	10	.200	.200	8
.01	.9000	11.70	.1837	.203	9.45
.02	.8586	12.23	.1767	.156	9.86
.03	.8268	12.56	.1713	.146	10.10
.04	.8000	12.80	.1667	.138	10.24
.05	.7764	12.97	.1625	.131	10.33
.06	.7551	13.10	.1588	.125	10.36
.07	.7354	13.19	.1553	.119	10.37
.08	.7172	13.26	.1520	.114	10.35
.09	.7000	13.30	.1499	.109	10.29
.1	.6838	13.32	.1460	.105	10.24

[For every e, E is computed from equation (12), w is computed from equation (8), p and n are deduced from equations (4D) and (5D), and u is computed from equation (1D).]

ii) Marginal Benefits and Marginal Cost of Increases in Expenditure on Education, where MC ≡ 1.

change in e	MB^w $\left((1-e)\frac{1}{w}\frac{\Delta w}{\Delta e}\right)$	MB^b $\left(\frac{(1-e)}{(1-p)}\frac{\Delta p}{\Delta e}\right)$	MB^W+MB^b-MC
.04 to .05	1.28	.48	.68
.05 to .06	.95	.42	.37
.06 to .07	.65	.39	.04
.07 to .08	.49	.36	-.15
.08 to .09	.28	.34	-.38
.09 to .1	.14	.30	-.56

E: Estimating the Return to Education

The moral of the story in the preceding section is that education can affect the national income by at least two routes. It can increase the productivity of labour and it can decrease the incidence of banditry. Education increases w and decreases n. In the top half of Table 2, the impact of education on the common utility of farmers and bandits is assessed directly. In the bottom half, it is assessed at the margin in a comparison of marginal cost (MC) and marginal benefits (MB^w and MB^b) of increasing the productivity of labour and reducing the incidence of crime. To derive marginal cost and marginal benefits from the model, it is sufficient once again to concentrate on equation (1D) because the utilities of the farmer and the bandit must be the equal in equilibrium. Since utility and consumption are defined to be the same for the farmer (though not for the bandit), the socially optimal e is that for which the consumption of the farmer is maximal, or, equivalently, Δc^f is approximately zero in response to a change in e. Differentiate equation (1D) totally with respect to e and replace derivatives with first differences. Thus,

$$\frac{\Delta c^f}{w(1-p)\Delta e} = \frac{(1-e)}{w}\frac{\Delta w}{\Delta e} + \frac{(1-e)}{(1-p)}\left|\frac{\Delta p}{\Delta e}\right| - 1 \qquad (13)$$

where the equation is scaled so that the extreme right hand term is equal to 1, and where Δp must be interpreted as the change in the equilibrium value of p in response to a change in e. The term $|\Delta p/\Delta e|$ represents the entire impact of education on the proportion of output that is stolen, a joint consequence of all of the equations in the model.

The terms on the right hand side of the equation (13) are marginal costs and marginal benefits. The first term, $\frac{(1-e)}{w}\frac{\Delta w}{\Delta e}$, is the marginal benefit of education, MB^w, in enhancing the marginal product of labour. The second term, $\frac{(1-e)}{(1-p)}\left|\frac{\Delta p}{\Delta e}\right|$, is at once the elasticity of the farmer's share of output with respect to the share of net output devoted to education and the marginal

benefit, MB^b, of education in reducing the incidence of banditry. The third term is the marginal cost of education, MC. This is equal to 1 by definition because the scaling of equation (13) converts the measure of e into units of consumption forgone. Thus equation (13) can be rewritten as

$$\begin{pmatrix}\text{net benefit}\\ \text{per dollar}\\ \text{of education}\end{pmatrix} = MB^w + MB^b - MC \qquad (14)$$

where the net benefit per dollar of education must be zero at the optimal value of e.

Values of the two marginal benefits of education, MB^w and MB^b, are shown in the bottom half of table 2 for small changes in e in the neighbourhood of the optimal provision of education. The sum of the marginal benefits must equal the marginal cost when e is optimal. It is evident from the table that the optimal e is about .07; expenditure on education in this model should be about 7% of the national income. Since the model of crime and education is atemporal, these marginal benefits are not true rates of return, but they would be proportional to rates of return in a more realistic framework.

Notice that the two marginal benefits are approximately the same size. The marginal benefit of education in augmenting the productivity of labour (MB^w) is somewhat larger than the marginal benefit in reducing the incidence of (MB^b) when e is small, but the opposite is true when e is large. If these numbers were realistic, they would signify that the usual estimates of the return to education are only half of what they ought to be. Of course, the numbers are not realistic, for they depend on arbitrarily-chosen values of the parameters in the model. But I can see nothing in the numbers to suggest that MB^b is obviously too large relative to MB^w. The table points to an interesting empirical problem.

F: The Bishop's Candlesticks

So far, all citizens are assumed to be exactly alike, with the same tastes, skills and inclinations. People do not become crooks because they are fundamentally crooked, but to maximize their incomes or utilities in circumstances where anybody else would do exactly the same. In fact, it is purely a matter of chance who becomes an honest worker and who becomes a bandit. Only the numbers of farmers and bandits are determined within the market. It follows immediately that the education of one randomly-chosen bandit - the inculcation of a special propensity to be honourable - can have no effect on the incidence of banditry, for, when a bandit turns to farming, the equilibrium in the labour market is disturbed and some farmer is induced to become a bandit.

The Bishop might have imagined that he was reducing the incidence crime by giving his candlesticks to Jean Valjean, but he would have been wrong. Instead, through the inexorable forces of the market, he provoked some unsuspecting citizen to take Jean Valjean's place. By saving Jean Valjean, the Bishop entrapped another into a life of crime. His gift was wasted. He induced someone to sin, and in doing so may well have sinned himself. That, at least, is the strict implication of the model as developed so far. Think of the Bishop's action as causing the value of E in equation (2D) to fall to 0 for some particular person, though E remains unchanged for the rest of the population. There can be no effect on the incidence of banditry because the reformed bandit changes places with some farmer and the equilibrium n remains the same as it was before. To affect the equilibrium, the Bishop would have to give candlesticks to all of the farmers and some of the bandits, inculcating an aversion to crime in a proportion of the population in excess of 1-n, where n is the equilibrium incidence of banditry prior to the gift. Similarly, education would be no deterrent to crime if provided

selectively to a small proportion of the population. To deter crime within this model, education must be universal or nearly so.

The assumption primarily responsible for this curious implication is at one extreme of a continuum of possible assumptions about people's taste for a life of banditry. The assumption is not that people are indifferent at any given level of consumption between farming and banditry, not that $E = 1$, but that people are alike in their aversion, or want of aversion, to crime. The assumption is that E, whatever it may be, is the same for everybody. The extreme opposite assumption is that some people are born criminals, while others are honest by nature. That assumption can be incorporated into the model by supposing that there are two classes of people with different values of E. For the honest folk who constitute a proportion $1-n^*$ of the population, the value of E is 0. For born criminals who constitute a proportion n^* of the population, the value of E is some large number. On this assumption, the equilibrium condition in equation (3) is no longer valid, but has become unnecessary because the proportion of bandits, n, has been transformed from a variable to a constant, n^*. On this extreme assumption, the Bishop's kindness is no longer wasted, for the reform of one criminal does reduce by one the number of criminals in society, and the conversion by education of one would-be bandit into an honest farmer does reduce the incidence of crime.

As neither extreme assumption is realistic, one might ask whether and to what extent the odd implication about the Bishop's candlesticks carries over to situations where people differ somewhat, but not radically, in their propensity toward banditry. One might ask whether an interesting intermediate assumption can be found between the two extremes and what that assumption implies about the provision of education. The natural intermediate assumption is that people's propensities toward banditry can be represented by a distribution function. Replace the function E(e) in

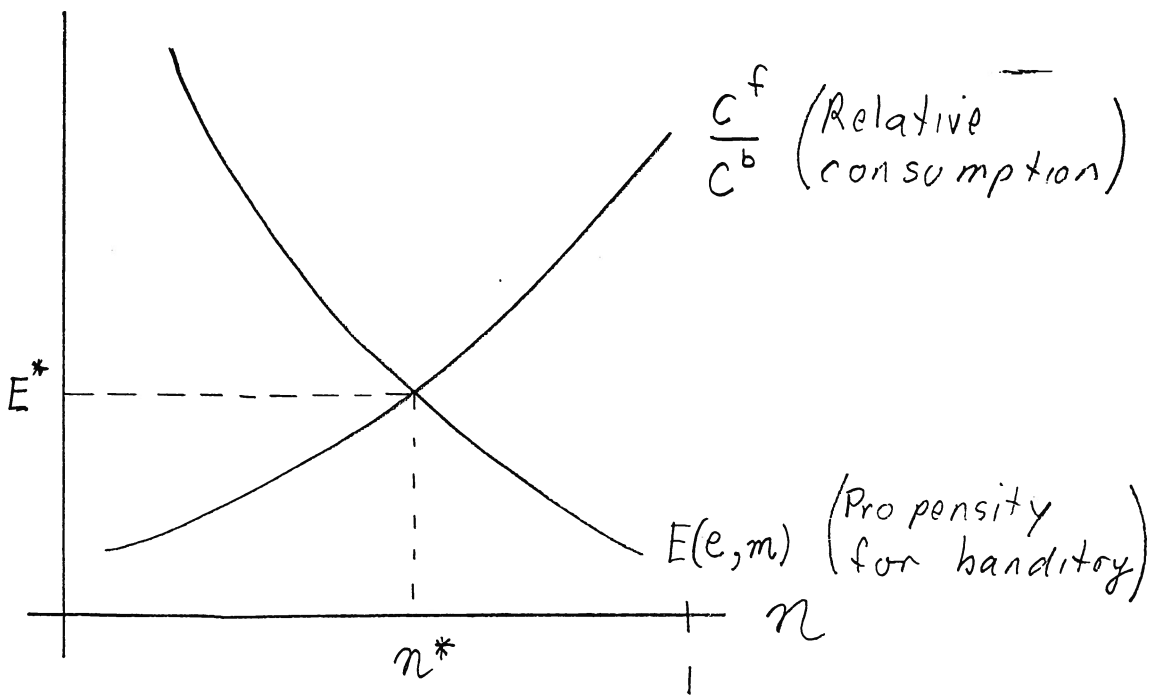

Figure 5: Equilibrium in the Labour Market when People Differ in Propensity for Banditry

equation (2D) by a function E(e,m) where the amount of education, e, plays the same role in E(e,m) as it played in E(e), and where m refers to the ordering of people according to the intensity of their distaste for banditry. Imagine people lined up according to their propensity for banditry, the person with the highest propensity (the least aversion for a life of crime) at the extreme left and the person with the lowest propensity at the extreme right. Define E(e,m) to be the degree of distaste for banditry of the person for whom a proportion m of the population has a greater propensity to banditry than he. The first derivatives of the expression E(e,m) are $\delta E/\delta e < 0$ and $\delta E/\delta m < 0$. With an expenditure on education of e and an incidence of banditry of n, the utilities of the mth farmer and the nth bandit become

$$u^f(e,m,n) = c^f(e,n) = w(1-p(n))(1-e) \qquad (1F)$$

and $$u^b(e,m,n) = E(e,m)c^b(e,n) = E(e,m)wp(n)(1-e)(1-n)/n \qquad (2F)$$

The equilibrium value of n is that for which $u^f = u^b$ <u>when m and n are equal</u>. Equilibrium can be identified by the equation

$$c^f(n)/c^b(n) = E(e,n) \qquad (3F)$$

where $c^f/c^b = \hat{n}/\hat{p}$ which is an increasing function of n but is altogether independent of e.

The functions c^f/c^b and E are illustrated as curves in figure 5, with the proportion of bandits on the horizontal axis. The "propensity for banditry" curve connecting E and n is downward sloping by construction, while the "relative consumption" curve connecting c^f/c^b and n must be upward sloping to reflect the technology of skulduggery, as is evident from figure 1. The equilibrium proportion of bandits, n^*, and the propensity for banditry of the marginal bandit, E(e,n*), are indicated by the crossing of the curves. Now the identity as well as the number of bandits is determined. Everybody for whom E is greater than $E(e,n^*)$ becomes a bandit, and everybody for whom E is less than $E(e,n^*)$ becomes a farmer. An increase in e has no effect on the

"relative consumption" curve but causes a downward shift in the "propensity for banditry" curve, so that the equilibrium number of bandits is necessarily reduced. The two extreme assumptions about differences in people's propensity for banditry can be represented in the slopes of the propensity for banditry curve. Our original assumption was that the curve is flat and that universal education leads to a uniform lowering of the curve. The opposite assumption is that the curve is vertical, in which case education cannot effect the location of the curve at all.

Once people are assumed to differ in their propensities for banditry, we are in a position to reconsider the effects upon the incidence of banditry of the education of identifiable groups of people. The principle governing these effects is that all of the action takes place at the margin. If, referring to figure 5, education alters the propensity for banditry curve in the neighbourhood of n^*, then the incidence of banditry is probably affected. Otherwise not.

Some interesting possibilities are illustrated in figure 6 which is an extension of figure 5 with the same interpretation of the axes and the same curves. Suppose additional education over and above e is provided to a group of people who occupy the space on the horizontal axis between n^1 and n^2 and whose original propensity for banditry lies between $E(e,n^1)$ and $E(e,n^2)$, and suppose education decreases their propensities for banditry to $\bar{E}$ which is less than E^*, the propensity for banditry of the marginal bandit in equilibrium. Three cases are shown in figures 6a, 6b and 6c.

In the first case as illustrated in figure 6a, n^1 and n^2 are both larger than n^* which means that the extra education is being provided to people who would have been farmers regardless. The effect of the extra education is to displace the educated people to the right on the horizontal axis, lowering the propensity to banditry curve by an amount $E(e,n^1) - E(e,n^2)$ at n^1, as those

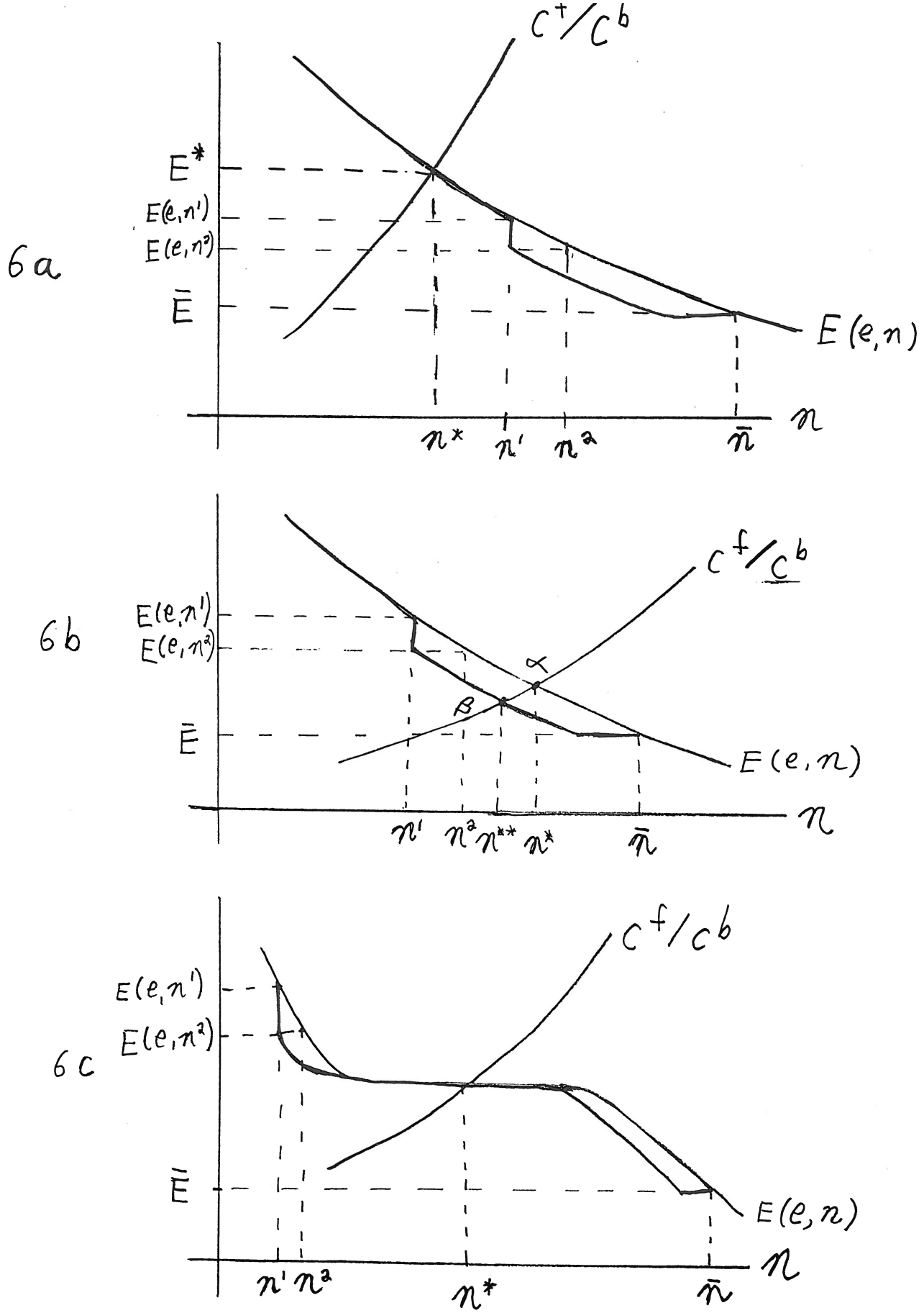

Figure 6: Targeted Education and the Incidence of Banditry

who formerly occupied the n^2 position come to occupy the n^1 position, and then adding a new flat segment at a height $\bar{E}$ as the recipients of the extra education are slotted back into the distribution. Define $\bar{n}$ to be the proportion of the population whose propensity to banditry was originally greater than $\bar{E}$; $\bar{n}$ is defined implicitly by the relation $E(e,\bar{n}) = \bar{E}$. The propensity to banditry curve is lowered between n^1 and $\bar{n}$, but it remains unchanged to the left n^1 and to the right of $\bar{n}$. Provision of the extra education affects the propensity to banditry curve within this range but nowhere else. And since, by assumption, the original equilibrium, n^*, does not lie within this range, there can be no impact on the overall incidence of banditry. The incidence of banditry is impervious to the education in this case.

In the second case as illustrated in figure 6b, n^1 and $n^2$are both less than n^*, which means that the extra education is being provided to a group of people who would otherwise be bandits, but it is supposed once again that $\bar{E}$ is less than E^* so that the effect of the extra education is to convert the educated persons from banditry to farming. The question becomes whether or to what extent the labour market restores the original incidence of banditry by inducing some people who were originally farmers to become bandits instead. The effect upon the propensity for banditry curve is the same as in the preceding case, except that, since n^1 is to the left of the original equilibrium and $\bar{n}$ is to the right, the dip in the curve spans the original equilibrium, causing the two curves to cross at β rather than α, so that the equilibrium number of bandits is reduced from n^* to n^{**}. As long as the new propensity for banditry curve is uniformly below the original in the neighbourhood of the equilibrium, the magnitude of the change in the incidence of banditry depends on the elasticities of the relative consumption curve and the propensity for banditry curve.

The third case, illustrated in figure 6c, is like the second except that the propensity for banditry curve is assumed to have a flat section in the neighbourhood of the equilibrium. To say that there is a flat section is to say that there are a significant number of people who are entirely alike in their distaste for a life of banditry. Not everybody need be alike. Some people may be quite reluctant to become bandits, others may be quite content to do so, and there may be gradations of preference within these groups. The assumption in figure 6c is that between the saints and the sinners is a broad band of people whose propensities for banditry are the same. As in the preceding case, extra education is being provided to people whose original propensity for banditry lies between $E(e,n^1)$ and $E(e,n^2)$, who would be bandits if the extra education had not been provided, and whose propensity to banditry falls, as a result of their education, to $\bar{E}$ which is less than E^*, so that they become farmers instead. However, the incidence of banditry is not affected at all in this case because of our new assumption about the shape of the propensity for banditry curve. Now, the effect of the education is not to lower the propensity for banditry curve over the flat section, but to push it to the right, so that, as is evident from the figure, the equilibrium has to remain as it was before. Once again, the Bishop has wasted his candlesticks. It is not necessary that everybody be identical for the incidence of banditry to be impervious to targeted, as distinct from universal, education. It is sufficient that people be identical in the neighbourhood of the equilibrium.

G: Public versus Private Education

The argument in this paper bears a family resemblance to Lott's view of education as indoctrination.

> "Government-provided schooling, like a government-owned news media, is used to decrease the cost of wealth transfers by changing the relative cost of acquiring different information and by predisposing students to support certain transfers. To instill the desired views,

> public teachers are given rents, and the possible threat of losing such rents serves as an incentive for the teachers to conform to the objectives set by the politicians. Further, the teachers are shielded from competition through the use of exclusive territories. If vouchers were used, the competition for students by teachers would underproduce the indoctrination not individually valued by consumers." (Lott, 1990)

There are two distinct arguments here, the general argument that education is, or can be, a vehicle for transmitting to the young the values and mores of society, and the specific argument that the transmitted values are, in fact, "predisposing students to support certain transfers".

I can hardly quarrel with the general argument, for that is precisely what I have attempted to demonstrate in this paper. As for the specific argument, I have two reservations. First, just as a totalitarian society may inculcate totalitarian values - fascism, communism or the glorification of the great leader - so may a democratic society inculcate democratic values of respect for civil rights, government by the people and so on. Consumers as voters are not altogether powerless. "Objectives set by politicians" cannot deviate too far from objectives of parents if the politicians are to remain in office. Admittedly, the direction of a public education can be, and perhaps is, biased by politicians and officials to some extent, but biases in public education are not necessarily more harmful than biases in private education, with or without a voucher system.

Second, there may be more to fear from indoctrination in private schooling than from indoctrination in public schooling. In the extreme, society must either tolerate what most people would see as dangerously anti-social forms of indoctrination - schools dedicated to supremacy of the white race or to the extermination of the white race or to the promotion of the teachings of the new Messiah - or the state must place rules and limits on private schooling, subjecting schooling to a degree of that bureaucratic surveillance which Lott fears.

There are problems well within the extremes. One of the great social challenges to democratic society today is the establishment of a reasonably unified and coherent people out of the mix races, languages, religions and cultures that most democratic countries have become. The spectre is Bosnia. The "civic" externality to education is not just the avoidance of ordinary crime. It is also the inculcation of patriotism as a defence against national disintegration. It is an ingredient of the old, essential line of division between church and state.

Public and private education may inculcate different ideals. Both would presumably promote the virtues of the honest life, but private education might take a marked sectarian slant as schools get established on religious, cultural or financial lines. Jewish children would come to study with other Jewish children in schools devoted the dissemination of Jewish values. Catholics with Catholics. Muslims with Muslims. Fundamentalist Christians with Fundamentalist Christians. Rich with rich. Poor with poor. There is no better way of teaching children that people in "their" group, whatever that may be, are in some sense better, more likely to treat one honourably and more worthy of honourable treatment than people in other groups - that outsiders are less deserving of consideration, respect or simple honesty - than to segregate children in education as a voucher system would almost certainly do. There is no better way of teaching the rich to despise the poor, or the poor to hate the rich. No preaching to the contrary can erase the lesson of proximity. The effect on society of widening the gaps between social classes may be quite similar to an increase in the citizen's propensity toward crime.

Two other considerations would seem to point in opposite directions. With or without a voucher system, private provision of education may be more efficient than public provision. The voucher system is intended to supply an

incentive for people to purchase more education than they would otherwise do, but at the same time to preserve the beneficial effects of the market and to avoid the inefficiency that public provision often entails. The economist need hardly be reminded that in "modern times, the diligence of public teachers is more or less corrupted by the circumstances, which render them more or less independent of their success and reputation in their particular professions."

On the other hand, the voucher system may in practice withdraw the implicit educational subsidy to the very poor in public schooling as we know it today. Even with a full-fledged voucher system, the children of the rich would certainly receive a more expensive education than the children of the poor, for the rich would supplement the voucher to buy their children into the best schools, while the poor would be unable to do so without great personal sacrifice. This process might improve the average quality of education but, at the same time, increase the variance considerably. Much depends on the magnitude of the subsidy, on the dollar value of the voucher. If the amount of the voucher is less than is now paid per head for public education, and if the gain in efficiency at the low end of the educational hierarchy is not considerable, then many, mostly poor, students will be badly educated. The voucher system may enable the rich to buy their children's way out of association with the mentally and physically handicapped. The voucher system may in practice be targeted away from precisely those students for whom enculturation is most important. There is also some risk that subsidies will be misused. It may in practice be difficult to prevent schools from converting educational vouchers into non-educational benefits for parents who are not especially concerned about the education of their children, those whose children may be most in need of education as a deterrent to crime. Revenue from vouchers may be diverted to food, clothing or perks for parents,

as distinct from education per se.

Not all education is equally externality-bearing. Since equal subsidization per student in a voucher system is consistent with considerable variation in the amount and quality of education acquired, the system may fail to provide the civic externalities which are analysed in this paper as the deterrence of crime. The discussion of targeted versus universal education in the preceding section raises the possibility the voucher system may not in practice convey a general and wide-spread attachment to the virtues of hard work, honesty and identification with the values of one's society. The voucher system may be like the targeted education in figure 6a which provides skills and may even inculcate good citizenship in some educated people, without at the same time reducing the incidence of banditry.

The balancing of these considerations - the general efficiency of private over public provision, the possible socialist bias in public education, the ethnicity bias in private education and the distributive consequences of a voucher system - is well beyond the scope of this paper. The discussion of targeted versus universal education does serve to emphasize that there is a balance to be drawn.

H. Conclusion

One can identify at least six distinct externalities to education, most of which are to some extent specific to the level of education or to the manner in which education is provided.

1) There may be a fiscal externality: Education of any person - rich or poor - is beneficial to the community in so far as total income is shared within the community by taxing the rich and subsidizing the poor. If this were the only externality, the private and social return to education would be the same, as long as the private return is measured by the education-

induced increase in the pre-tax income of the educated. In this case the Bishop would have wasted his candlesticks unless the "income" passed from the Bishop to Jean Valjean would be more heavily taxed in the hands of the latter than in the hands of the former.

2) There may also be a "technical" externality: Regardless of the tax system, education may generate innovation that is not reflected in the remunerated of the educated. A person, if educated, might invent a new product or mode of economic organization with benefits that cannot be captured by the patent system for the inventor. A discrepancy between the private and social return to education would emerge in this case. The rate of economic growth may be dependent on the share of expenditure on education - all education or higher education alone - in the national income. (Creedy and Francois, 1990, Hartwick, 1992, Jorgenson and Fraumeni, 1992.)

3) There may be an altruistic externality: One educates one's children today because of a concern for their welfare tomorrow. That concern may extend from one's own children to the entire generation of children in one's society. Concern for all of the poor in one's society is a warrant for ordinary redistribution rather than the subsidization of education. Altruism generates an externality to education when directed especially to the next generation, when the altruistic are more concerned about the children of the poor than about poor adults now. An altruistic externality would warrant public provision of schooling or subsidization of the schooling of the poor. Buchanan's emphasis in a recent paper on "education as empowerment" has a family resemblance to intergenerational altruism, though the two are not quite the same (Buchanan, 1992).

4) An externality may be associated with the income elasticity of the propensity to crime. Prosperous people may commit fewer crimes than poor people because the alternative cost of crime is higher [The wealthy have

better ways of earning a living than mugging passers-by on the street], or because they have a higher alternative cost of imprisonment. In so far as education increases the earning power of the educated, it must also reduce the propensity to crime, conveying a benefit on society not reflected in the return to the educated. Alternatively, within the context of the model of this paper, one might suppose that one must learn how to be a farmer (that one cannot farm without some education), but that one is born with a knack for banditry. In either case, education provides the means to an honest life, not the inclination.

5) There may be a sheepskin effect. Though university teaches nothing of use, one's capacity to pass exams may be the only available indicator of innate ability, in which case education serves to assign people to the appropriate jobs. I would imagine that the private return to education is in excess of the social return in this case (Arrow, 1973).

6) There is a civic externality which is the subject of this paper. Children learn to prefer the life of an honest citizen to a life of crime. The purpose of this paper has been to isolate the civic externality and to draw out its implications in a simple context where those implications are not masked by other considerations. That the civic externality occurs in a context where there are other externalities as well does not invalidate the analysis in this paper because the different externalities are not at bottom contradictory. The special characteristics of the civic externality - its primary association with elementary education, with universal provision of schooling, as distinct from the special education of the more talented members of the community, and with public rather than private education - should be seen as important considerations for educational reform.

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