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THE THEORY OF "SCREENING," EDUCATION, AND THE DISTRIBUTION OF INCOME

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by

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1. Introduction

We conventionally think of information as a public good; indeed, with national defense, it is one of the few examples of a pure public good:¹ the marginal cost of an extra person using information is zero.²

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This is a shortened version of an earlier paper entitled "Education as a Screening Device and the Distribution of Income." I am indebted to Gary Fields, Michael Rothschild, Michael Spence, and to participants at seminars at Yale, Pennsylvania, Chicago, Queens, Wesleyan, and Princeton at which earlier versions of this paper were presented, for helpful conversations and comments. Related research is described in Fields' paper [7]. Several of the ideas presented in this paper are closely related to those developed independently by M. Spence [19] and Arrow [2]. My interest in these questions was originally stimulated by conversations with George Akerlof while we were graduate students at M.I.T. in 1964-5. His innovative work in this area has regrettably remained unpublished; his theory of "lemons" [1] forms one important part of the general theory of "screening." Other contributions to the "Theory of Screening" include Salop and Salop [17], Rothschild and Stiglitz [14, 15], and Phelps [10].

¹In the sense defined by Samuelson [18].

²We may note here a distinction between the cost of transmitting information and using information. Even the former is usually low relative to the cost of producing information.

Yet, with few exceptions, the production of information is left to the private sector. In the case of some kinds of information--patentable inventions--the government provides a method by which some part of the benefit of the invention accrues to the discoverer.¹ But for most kinds of information, e.g. the distribution of prices of a commodity, the patent system is irrelevant, and we have little theory about the economics of those kinds of information.²

One of the important kinds of information concerns the qualities of a factor or a commodity. We know that there are important differences between different individuals, between different bonds, different equities, different brands of automobiles. The identification of these qualities we call labelling, and devices that sort out commodities (individuals) according to their qualities we call screening devices (e.g., egg sorters).

We focus in this paper on the labelling of individuals, on the economic costs and benefits of labelling, the institutions that provide it, and the determination of the equilibrium amount of labelling (screening) under various institutional arrangements.

The basic argument of this paper is that there is a kind of externality inherent in the existence of differences among individuals in economies without perfect information (perfect labelling) if the screening process is

¹Whether the patent system results in an under or over supply of invention, whether it is the best way of ensuring that private individuals capture the rewards to the invention, and whether those rewards correspond to the social marginal productivity of the inventor are questions dealt with elsewhere (see, e.g. [8, 9, 21]).

²See, however, Stigler [20] and Rothschild [12], and the papers cited there.

costly, and that one can show equilibria in which everyone is worse off as a result of screening than they would be in its absence. On the other hand, there are situations where screening does have social returns, so large in fact that everyone is better off with screening than in its absence.

We argue that educational institutions are one of the major institutions for providing information about the individual, about his capabilities, strengths, and weaknesses. Social returns from education differ, however, systematically from private returns, resulting in a non-optimal level of expenditure on education. The nature of this non-optimality depends on the particular institutional arrangements for the provision of the education. For instance, if there are comprehensive public schools, with the equilibrium level of educational expenditures determined by majority voting, there will be too much expenditure on public schools. But there is a presumption that the level of expenditure in private school systems as well as in mixed private public school systems will not be "optimal."

We begin our analysis with an example to clarify the meaning of labelling, to show the nature of the externality it introduces, and the consequent non-optimality of the equilibrium that may result. In Section 3, we discuss some of the more important social returns to labelling. In Section 4, we focus on the question of the private returns, or to put the matter another way, who would pay for screening in a privately organized economy. In Section 5, we turn to the institutions which do the screening, and in Section 6, to the mechanisms by which the screening is done, focusing on the educational system as a "screening device." In Section 7, we discuss in a fairly general way how the design of the educational system affects

the performance of the screening function. Section 8, examines in detail the majority voting equilibrium in a public comprehensive school system. Section 9 discusses private and mixed public-private school systems.

2. The Benefits and Costs of Screening: An Example

Consider a population in which individuals can be described (at least for economic purposes) by a single characteristic, which we denote by θ , and which is proportional to the individual's productivity,¹

$$p = m\theta .$$

We choose our units so that $m = 1$. The fraction of the population that is of type θ is given by $h(\theta)$.

If all individuals were (known to be) identical, it would be a relatively simple matter to discover the value of θ for a representative man, and once that was discovered, that would determine the wage to be received by all individuals. But if individuals (are known to) differ from one another, then it may be in the interests of the individual to have his ability certified.

Assume that the individual knows his ability but the market does not, and in the absence of any information treats all individuals identically. Firms are risk neutral, and so pay a worker the mean marginal product.

¹That is, an individual of type θ_2 can do, in an hour, what a worker of type θ_1 can do in θ_2/θ_1 hours. p can be interpreted as the individual's marginal product.

Assume moreover that the individual is assigned to an assembly line, and that on the assembly line it is impossible to tell the productivity of any single individual without prohibitively costly examination. The speed of the assembly line is determined by the average value of θ for those working on the assembly line. Thus, if the more able individuals are able to be identified, and so assigned to a faster moving assembly line, they will receive a higher wage; they thus have an economic incentive to be identified. Assume there is a screening process which costs c^* per individual, and which screens perfectly.¹

Consider a case where there are only two groups, denoted by θ_1 and θ_2 , $\theta_1 > \theta_2$, and which we refer to as the more able and the less able, respectively. We assume c^* is such that

$$(2.1) \quad \theta_1 - \theta_2 > c^* > \theta_1 - \bar{\theta}$$

where

$$(2.2) \quad \bar{\theta} = \theta_1 h(\theta_1) + \theta_2 (1 - h(\theta_1)) = \text{average value of } \theta .$$

First we consider a case where the supply of labor by each individual is inelastic, so that with perfect knowledge, the first group would receive an income of θ_1 and the second an income of θ_2 .²

¹ Implicitly, we assume that the technology of screening is such that if less than c^* is spent, there is no screening, i.e. labels are assigned randomly.

² There are best thought to be life-time incomes, i.e. present discounted values of wage streams.

We now establish that there are two equilibria:

- (a) The no-screening equilibrium. Since no differentiation is made among individuals, they all receive the same income, equal to the mean productivity of the population, $\bar{\theta}$. To see that this is an equilibrium, observe that it does not pay any individual, in particular, it does not pay the more able individuals, to be screened. For with screening, he would obtain a gross income of θ_1 , from which we must subtract the cost of screening to obtain net income, $\theta_1 - c^*$, and by (2.1), this is less than the income he would have received in the absence of screening, $\bar{\theta}$.
- (b) The full screening equilibrium. The individuals of type θ_1 receive a gross income of θ_1 , a net income of $\theta_1 - c^*$ (after paying for screening costs); individuals of type θ_2 receive an income of θ_2 . Since these individuals know that they are the less able, they do not pay for any screening. Clearly, it pays individuals of type one to pay for screening. By our assumptions, all individuals who are not screened are "lumped" together and receive the same wage. In this case, an individual of type 1 would have received an income of θ_2 , which, by (2.1), is less than his net income with screening.

This simple example illustrated four propositions concerning economies with screening:

- (1) There may be--our examination of a wide variety of models indicates that there are likely to be--multiple equilibria.
- (2) Some of the equilibria are unambiguously Pareto inferior to other equilibria. Note that in the full screening equilibrium, both groups have lower net incomes than in the no-screening equilibrium: the first

group has an income of $\theta_1 - c^*$, which by (2.1) is less than $\bar{\theta}$, the second group an income of θ_2 which is obviously less than $\bar{\theta}$.

- (3) In both equilibria, it can be said that the presence of the less able individuals imposes a (negative) externality on the more able; in the absence of the second group, the first group would have received a wage of θ_1 ; in both of these equilibria their incomes are lower. Conversely, the presence of the more able may confer a positive externality on the less able (in the no-screening equilibrium, they receive an income of $\bar{\theta}$ rather than an income of θ_2), but need not (as in the full screening equilibrium).
- (4) If one of the functions of education is to screen individuals, as we shall argue later, social returns (ignoring distributional effects) differ from private returns. The gross social return, in this example, is zero (since the only effects of screening are distributional), the net returns are negative (since there is a cost). But the private rate of return to education for the more able is clearly positive:

$$\frac{\theta_1 - \theta_2}{c^*} .$$

Many screening equilibria, however, have the characteristic that some individuals are better off than they would be in the absence of screening, some individuals are worse off, but total net national output is lower. One might be inclined to conclude that such a screening equilibrium is not Pareto Optimal, but one must be careful. Assume that instead of (2.1),

(2.1') $\theta_1 - \bar{\theta} > c^* .$

Then there would not exist a no-screening equilibrium, but the losses to group 2 exceed the gains to group 1. Clearly, if we forbade screening, we could compensate the upper group and divide the costs of screening among the population to make everyone better off. Such an argument misses however the essential nature of screening: neither the government nor the private producing sector knows who is more able without screening, hence, in this example, even though with screening net national output is lower than without it, the screening equilibrium is Pareto Optimal since the redistributions which would be required to make "someone better off without making anyone worse off" than they were in the screening equilibrium, are not feasible in the absence of the screening itself.

On the other hand, since the screening does lower net national output and increase the inequality of income, under any quasi-concave (equality preferring) social welfare function the screening equilibrium just described is socially undesirable (see [3, 13]).

It would, however, be misleading to conclude that screening always is undesirable. Consider a simple modification of the above example, in which labor is now elastically supplied. In the absence of information, individuals receive a wage which differs from their true marginal product. Imperfect information acts just like a wage tax on the more able, a wage subsidy on the less able (see [4]). Like all taxes, the "information wage tax" is distortionary in its effect on the consumption-leisure decision. If the distortion is large enough, everyone can be made better off as a result of screening (provided we have the appropriate tax instruments). This is illustrated in Figure 1 where we have shown the individuals'

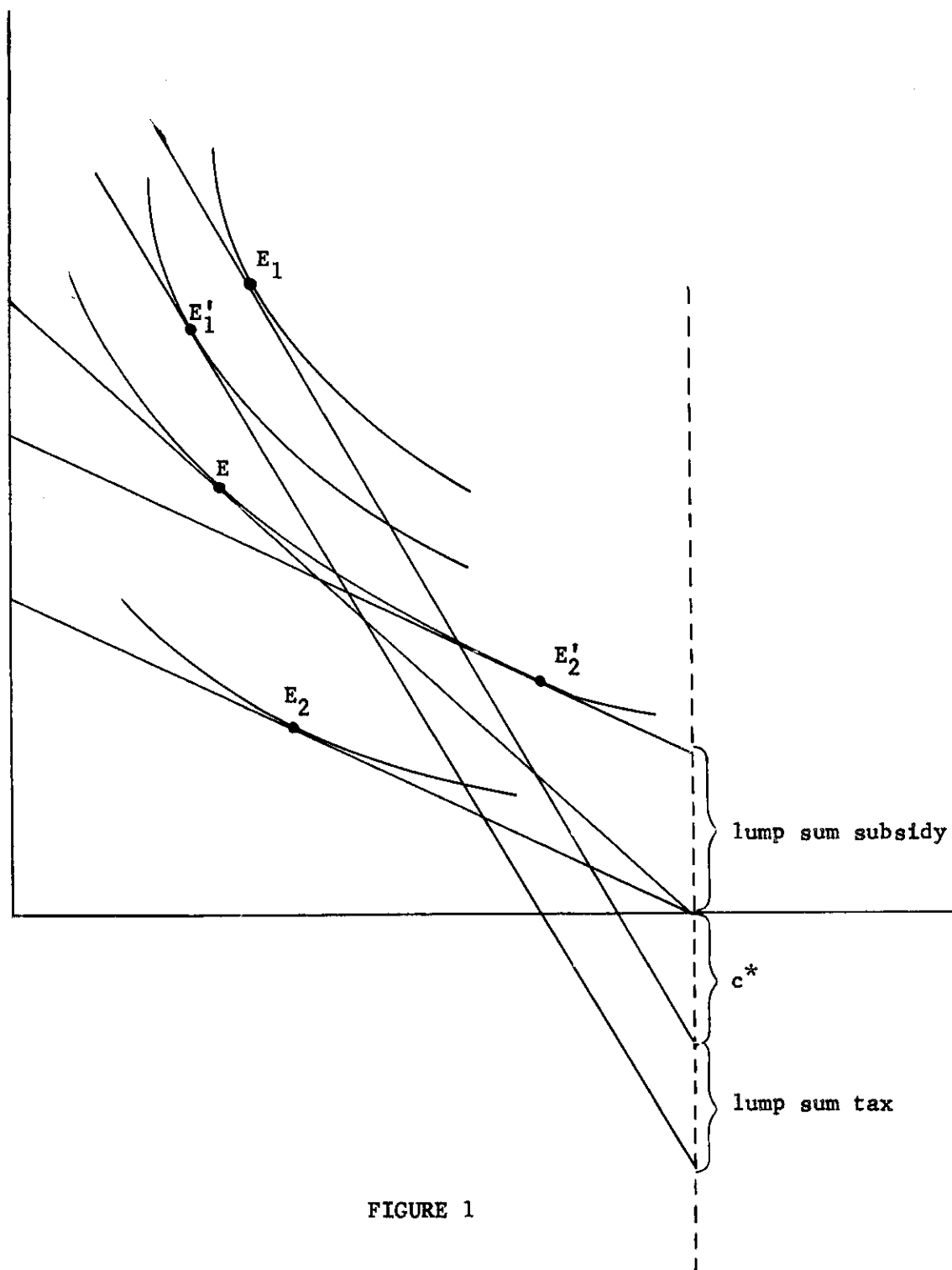


FIGURE 1

consumption-leisure indifference curves. The initial equilibrium is at point E . As a result of screening, in the absence of taxes, the upper group moves to point E_1 and the lower group to E_2 . We now impose a lump sum tax on group 1 (alternatively, a tax on screening expenditures) the proceeds of which are redistributed to the less able (group 2) in the form of lump sum redistributions. We then restore the lower group to the same level of utility as it had before (at point E_2') while the upper group is better off than before.

We have thus shown that screening may make all individuals better off than they would be without screening. Often, however, the requisite redistributive taxes may not exist; in that case, some of the gains of the more able are at the expense of the less able. We would like to know when will national income be larger with screening than without. (a) First, it is clear that if there exists a no-screening (no tax) equilibrium, it cannot increase net national income to undertake screening, since private gains of the upper group exceed social gains, and if it does not pay them to be screened, it certainly can not increase national income. We shall show later that this conclusion does not hold if individuals are risk averse and are uncertain about their abilities. (b) The converse of this, however, is not true: there may exist full screening equilibria which are not only net national income maximizing, but even Pareto inferior, as in the earlier example. (c) Thirdly, if screening were essentially costless (c^* were arbitrarily small), it would always pay to have screening; provided the government could impose wage taxes and subsidies; no screening is equivalent to imposing a wage tax-subsidy which equalizes all after tax wages, and

this can be shown to be non-optimal (see [4]), even if society exhibits the extreme desire for equalitarianism represented by the Rawlsian objective function, of maximizing the minimum level of utility.¹

3. The Social Benefits from Screening

We shall attempt here to separate out "social" as opposed to "private" benefits from screening. The latter, we argued, are partly redistributive in character. There are, however, four important sources of "social" gains:

(a) Consumption-leisure decision. We argued in the previous section that imperfect information about abilities was equivalent in its effect to a wage tax (subsidy), since the wage the individual receives is different from his "true" productivity. Better information reduces the resulting distortion.

(b) Comparative advantage. It is widely recognized that individuals differ in the comparative skills with which they can perform different tasks (jobs) and the ease with which they learn different skills. The latter has important implications for the allocation of educational resources. The "efficiency" losses in attempting to train a moron to be an engineer are obvious. Similarly, if the typist has a comparative advantage in plumbing, and the plumber a comparative advantage in typing, we can have both more typing and more plumbing if they "switch" jobs.

¹ Only if society has an infinite aversion to income differences, an objective function would be inconsistent with the Pareto Principle, would no screening be desirable.

(c) Absolute skill levels and joint production. In many economic activities, individuals act together. What is easy to observe is the net output of the group, but this in turn is a complicated function of the different qualities of the individuals of the group. In the previous section, for instance, we considered an assembly line the speed (output) of which was simply the average of the "productivities" of the individuals working on the line. It would perhaps have been more accurate to assume that it is a weighted average, with the individuals who are below average slowing the line down by more than those who are above average speed it up. In that case, total output would be greater if we had two assembly lines, one with slow workers, the other with fast workers, than if the workers were randomly mixed together. Although this example is based on the assumption that there are returns to group homogeneity, the argument that there exists social returns only requires that output depend in part on how individuals of different characteristics are grouped together.

(d) Absolute skill levels with training costs. A similar argument can be made with respect to man-machine interactions. Assume that there are different kinds of machines for producing a given level of output. There is a large training cost associated with the operation of each machine; training for one machine does not equip one for operating another. Each machine is optimally designed for an individual of a given ability (value of θ), as illustrated in Figure 2.¹ What

¹A similar analysis was presented in [15,22]. The similarity between this and "putty-clay" models in capital theory should be obvious [6].

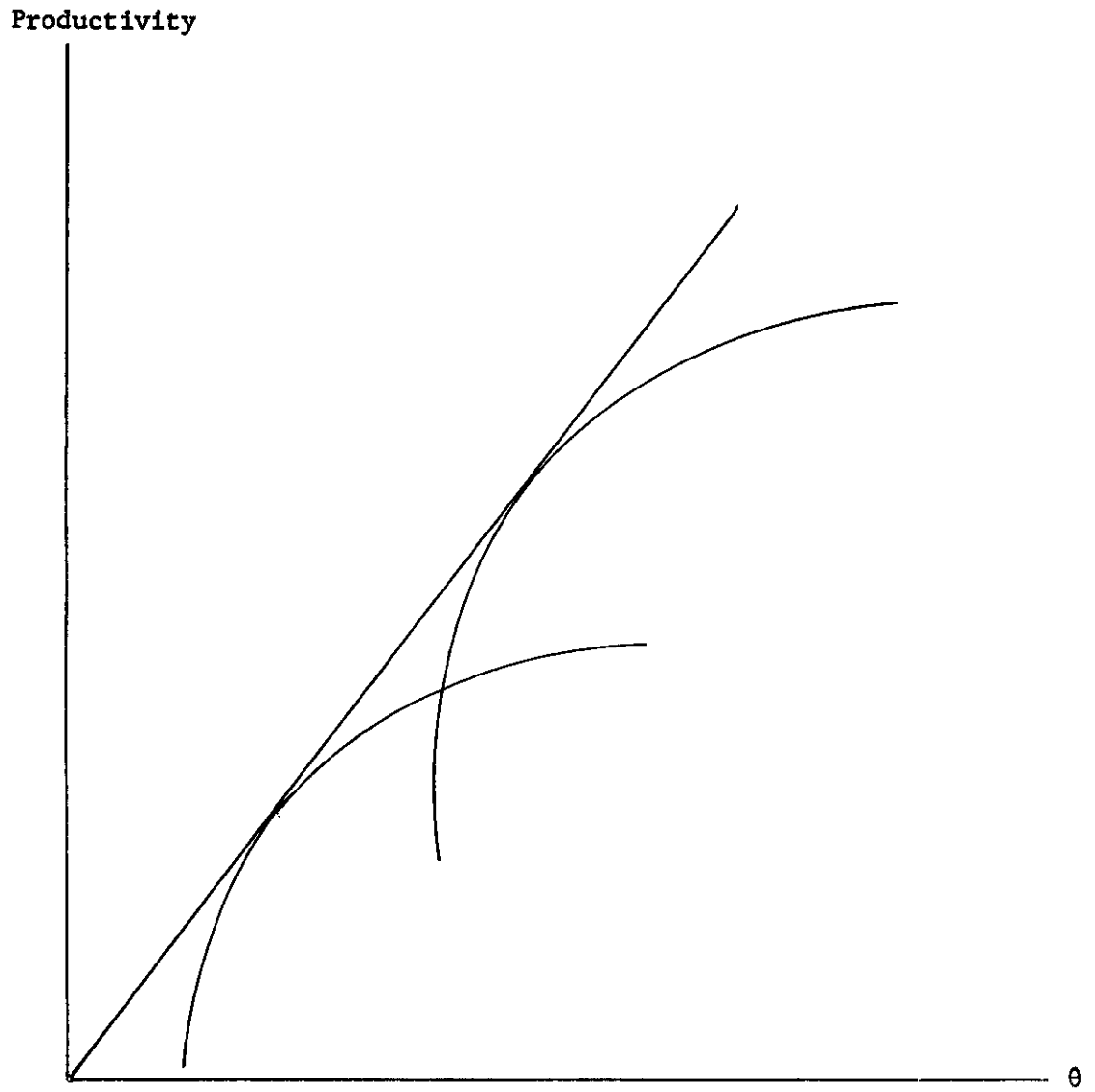


FIGURE 2

kinds of machines should be constructed and should we assign to different individuals? Clearly, there are social returns to knowing the individual's ability (θ).¹

4. Private Returns to Screening: Paying for Screening in a Private Economy

In the previous sections we have argued that there are social returns to screening as well as private, but the two may well differ. In this section, we enquire into who obtains returns from screening, i.e. who would pay for screening in a private economy.

We need to distinguish between two kinds of information: general and specific. General information is information about characteristics of an individual which affect his productivity in a wide variety of jobs, specific information concerns characteristics which affect his productivity on a specific job in a specific firm, e.g. his ability to operate a particular machine. The distinction corresponds to Becker's [5] distinction between general and specific training; these are clearly polar cases; as with training, there is a continuum of degrees of specificity/generality of information.

In this paper, we shall be primarily concerned with general information. We shall argue, that in a private economy as a first approximation, the benefits of information accrue to and the costs of information would be borne by the individual as opposed to the firm.

¹If there were no training costs, we could quickly observe the output of the machine with any individual, and infer his ability from this.

To see this, consider an economy in which individuals did not provide information about themselves. The wage in competitive equilibrium would be equal to the mean marginal product of the workers, and all workers would receive the same wage. Now assume that some firm did research which detected which workers (or groups of workers) were more productive. If it were able to keep that information secret, it would be able to earn, as a return to obtaining that information, the difference between the marginal productivity of these workers and the average of the population as a whole. Thus, it would pay firms to do research to obtain this information.^{1,2} If the information were to become public, however, the worker would receive the benefits of the information: other firms would bid for his service, until his wage rose to his marginal productivity.

There are thus two conflicts of interest: the worker wishes to have all such information public, the firm private; and to the extent that some of the return is captured by the worker, the firm will not allocate as much resources to obtaining information about the quality of the individual as the more able individuals would have liked.

¹Provided, of course, that the costs of obtaining the information are sufficiently low.

²As we noted before, the private returns have no correspondence with the social returns. In this particular case, there may be no social returns, just a redistribution of income, a gain of the firm doing research at the expense of the other firms and individuals. The other firms would soon discover that the mean marginal productivity of their workers was smaller than it had been previously, and the wage of these workers would adjust accordingly.

We have so far established that the most able individuals have an economic interest in providing information about their capabilities.¹ But the gain of the more productive workers is at least partially at the expense of the less productive workers. If the rearrangement of workers among firms resulting from the information about which workers were the most productive had no social productivity associated with it (i.e. the increased productivity of the firm using the more productive workers is exactly compensated by the loss in productivity of the other firms), as it might, then the gains of the more productive workers are completely at the expense of the less productive workers. It is thus in the interests of the poorer workers for the information about who is the best worker not to be known. We shall now argue that, if information were relatively costless, in a competitive economy everyone except the poorest (least capable) individual has an economic interest in providing such information. To continue with our example, assume the most able student is able to provide information certifying to his abilities. The market would then, in equilibrium, pay the remaining workers their (now lower) average marginal productivity. It would clearly pay then for the most able person of this group to have his ability certified. And the analysis proceeds, until information about the capabilities of all individuals except for the least capable is provided: but if we have sorted out all except the least capable, we have also sorted out the least capable.^{2,3}

¹It is crucial to the argument that individuals have more information about their own abilities than the market does (or at least that some individuals believe that, were they not to provide information about themselves the market would underrate them). See below, p. 16.

²The same kind of notion has been applied to the supply of information on the capital market. See Stiglitz [21].

³This may be called the Walras' Law of screening information.

Our basic argument can be summarized as follows: since individuals are able to capture the returns to general information about their skills themselves, they are willing to spend resources to provide this information.¹

It can similarly be shown that as a first approximation the costs of specific information will be borne by the firm.

Several qualifications to this analysis are in order.

First, there are some conditions under which it may not pay even the most able to pay to be screened: (a) If there are self-employment opportunities where they can realize the same returns that they would have realized had they been accurately screened, any "underrated" individual would be self-employed. For most individuals, this is not a relevant possibility.²

(b) If individuals are perfectly certain of their ability, and if it is possible for their ability to be costlessly observed "on the job"

¹There is a difference between this argument and the argument that general training costs would be paid for by the individual. In the latter case, once trained the individual could obtain the higher wage corresponding to his new higher productivity by threatening to quit, since other firms would pay him this higher wage. In the case of general information, it is only if the information is public that the individual is able to obtain the higher wage. If the firm were able to keep the information secret, it could obtain the return to the information. In the case of general training, the individual pays for it because the firm will not. In the case of general information, the individual pays for it because that is the only way he can capture the full returns to his differential skills.

²That is because most production activities are group activities involving several individuals and require capital (and because of "capital market imperfections" the individual may not acquire the requisite capital at "the market rate of interest") and there are probably large transactions costs in setting up one's own firm. It is well known that on average returns to factors are lower in self-employment activities than in the corporate sector. Perhaps this is a reflection that the self-employed sector attracts individuals who believe that the corporate sector would undervalue them; on average, these are individuals who overestimate their own ability. Accordingly, they anticipate getting a return at least equal to that in the corporate sector, but turn out to get a smaller return.

then the individual would offer to absorb all the risk involved in hiring and training costs. There are obviously instances of this sort, individuals who persuade the employer to hire them at low wages until they can "prove themselves." But for many jobs, ascertaining abilities (productivities) on the job may be relatively costly, and most individuals are not perfectly certain of their abilities.

(c) If individuals are very risk averse and not perfectly certain of their abilities, then they might prefer to be treated simply as average than to undertake the chance of being screened and labelled below average. As an extreme case, assume that individuals had no prior information about their abilities, i.e. their subjective distribution of their ability θ was identical to that of the distribution of individuals in the economy. Then, even if there is a social return to screening (i.e. it would increase net national product), there may be a no screening equilibrium. Assume, for instance, that the return to screening is the ability to assign individuals to the "correct" kind of machine. The mean marginal product of labor with perfect screening is larger than without screening. But so is the variance of the individual's income; the net effect on expected utility depends on the degree of risk aversion. Sufficiently risk averse individuals will clearly not "buy" screening, even if it were essentially costless. On the other hand, if the information about the kind of machine an individual works on was easily ascertained, then it would not pay any firm to do screening if there was any cost associated with it, even if the firm were risk neutral. For other firms would bid away the more productive workers. The firm doing the "research" would not be able to capture the returns.

Thus, unlike the previous cases we analyzed, where the expenditure on information was greater than that which maximized net national output, here there is too little expenditure on screening, without government intervention.

More generally, if individuals are risk averse and are not perfectly certain of their abilities, and if the firm's evaluation of the individual's abilities can be kept partly secret (or if there are time lags in its becoming "public") then there will be some expenditure on "general information" by the firm.

On the other hand, some part of the "benefits" of specific information will accrue to the individual and hence he will have some motivation to pay for some of it. The reason for this is that if there are costs to obtaining specific information, and if all the costs and benefits of the information accrued to the firm, there would be real social costs associated with labor turnover which the worker would not bear. This would not be a problem if there were indentured servitude or slavery; and its importance is somewhat alleviated by vested pension rights and other mechanisms to discourage labor turnover. Nonetheless, the payment of a higher wage is one important method of discouraging labor turnover, and so, just as firms with higher (specific) training costs tend to pay higher wages because the reduction of labor turnover is more important to them, so to with firms with higher specific information costs (see [16, 23]).

5. The Producers of Screening

In previous sections, we have considered the benefits and costs of screening, and the payment of the costs of screening in a private economy. We now turn to the question of who will produce the information, i.e. who will do the screening.

We argued earlier that it was in the interest of the individual to have information about himself provided. To have value, the information must be "certified" by a disinterested party, by a public institution (although not necessarily a governmental institution). For it is clear that it may be in the (short run) interests of the individual to provide misinformation, to overstate his abilities. When a firm promotes an individual, this is information about the firm's judgment of the individual's abilities, when Mohammed Ali says that he is the greatest, that contains little information. (There are indirect methods of "screening", what we call self-selection mechanisms, which we shall discuss later.)

There are two groups of institutions which do screening. Those which are primarily concerned with screening, and those which do screening as a byproduct of other activities. The College Entrance Examination Board and employment agencies are the main examples of the former; educational institutions and on-the-job screening are examples of the latter. We focus here on educational institutions for two reasons: (a) the screening done by the educational institutions is the primary determinant of one's job opportunities, and hence of what screening can occur subsequently. (b) On-the-job screening is largely concerned with specific information, or in any case non-public information.

Why educational institutions? Educational institutions provide information about individuals' abilities for a number of reasons:

- (a) The efficient allocation of scarce educational resources requires the identification of different individuals' abilities, i.e., some individuals would gain little from a Ph.D. program in economics, but would clearly benefit greatly from a course in automobile mechanics, and conversely for other individuals.
- (b) Most educators would argue that even within a given educational level there are returns from recognizing that some individuals learn certain skills faster than others.
- (c) Part of the social marginal product of educational institutions is finding each individual's comparative advantage (as educators are wont to say, "helping the individual find out about himself") and information about absolute advantages is almost an inevitable by-product of obtaining information about comparative advantages.
- (d) In the interchange between teacher and student which is common to many (but not all) educational processes, the teacher obtains a great deal of information about his students. The fact that there are a large number of teachers making these "observations," makes the information more valuable than the judgment of a single individual (e.g., employer).

In short, it is hard to imagine an educational system which did not obtain a great deal of information about individuals.^{1,2}

¹Not all educational processes involve screening; that is, large lectures may impart a great deal of information, but the teacher need never ascertain how much of the information the student has absorbed. Some students have even argued that screening diverts them from "real" education to the acquisition of the particular skills and pieces of information which will be tested. Our analysis is predicated on the fact that all educational systems do some screening. This is for the reasons mentioned above. If only the third reason were involved, it could be done by agencies other than the educational system. Agencies other than the educational system are in fact involved in screening. Our point is only that the information required for the efficient running of an educational system and the information often (but not always) acquired as a byproduct of educational processes about individuals has market value, e.g. performance in school is correlated with market performance (note that better performance in school may be negatively correlated with performance in some jobs--the so called "over-trained worker": but in general, better performance in school increases expected wages). Some school systems (France?) particularly at the higher level, are concerned almost exclusively with screening; that is, lectures and classes are relatively unimportant, the student is responsible for acquiring the skills on his own, and the school only certifies that he has done this.

²If there are further stages of screening (on the job screening), we require only that information about school performance and performance in the subsequent screening is a better predictor of productivity than only the latter information, e.g. the "true" productivity of a group rated high (A) in the school system and in the next stage of screening, is higher than that of a group rated (B) in the school system and (A) in the next stage of screening. (Similarly for the sequential screening within the school system; see Arrow [2].)

6. The Provision of Screening Information: The Screening Mechanisms

As discussions of grading systems make clear, there is, however, an important difference between obtaining information and making it public.¹ There are several mechanisms by which such information about the individual's capabilities become public:

(1) If the education system does any sorting for its own purposes --as it must (not all individuals can benefit from the same educational experiences; some would not benefit much from an academic university training)--the groups into which an individual have been sorted will convey some information to the firm about the individual.

(2) Another mechanism is performance tests: individuals have been confronted with roughly similar learning experiences (say geometry); some individuals "learn" the geometry better than others; this fact may be ascertained by a "grade" from the teacher, or by "standardized" objective examination. Failure to pass a course in college, or failure to pass a grade in elementary and secondary schools, conveys a great deal of information, which adversely affects the wages received by those individuals. As long as the school system does any grading, if only on a pass-fail basis, it is providing some information; and even when it does not do the grading itself, others can do the grading for it (GRE, etc.).²

¹One might well argue that it is inefficient to obtain information and not make it available.

²In this sense, the discussion about grading systems intruding upon the educational system is irrelevant in market economies; individuals will inevitably be graded upon their performances so long as performance in these areas are correlated with performance in their job. The question is the form in which the grading evaluation is to take place.

(3) A great deal of information is provided, however, by self-selection:¹ Self-selection mechanisms work as follows. Consider any characteristic of an individual which the individual has more information about than the firm. (We do not require that the individual have perfect information, only that on average that they are better informed than the firm.) Some individuals have "more" of the given characteristic than others, e.g. more brains, more mechanical ability, a higher turnover rate. We construct two (or more) reward penalty structures such that on average individuals with "more" of the given characteristics will do better under one penalty-reward structure than under the other, and conversely. If individuals are asked to choose among these reward penalty structures, and if they are rational, they will sort themselves out into those who have more of the characteristic and those who have less. (The better the information of the individuals, the greater the differential rewards the better the sorting will be.)

¹The notion of self-selection is also discussed in Salop [17]. Consider a group of individuals entering the job market for the first time. Some are stable individuals, i.e. are likely to stick with the same job for a long time, others are unstable (likely to quit shortly). The firm cannot tell them apart, but the individuals know which kind of individual they are. Assume we have two kinds of firms, those with high specific training costs, and those with low specific training costs. It is obviously more "efficient" if the more unstable individuals go to work with the firms requiring less training costs. A seniority wage structure is one method by which individual will sort themselves out; those who do not expect to stay very long will not accept the low wage in anticipation of a high wage in the future. Note that it is not the firms who are discrimination against the unstable individuals; the individuals are doing the self-selection.

The notion of self-screening is related to Akerlof's theory of lemons [1]. Akerlof argues that the used car market is a self-selection mechanism in which the worse cars become traded.

Assume that wages were a function of the number of grades completed, and the length of time to complete a grade was a function of the individual's ability. Then if the two functions (the wage function, and the function relating the length of time to complete a grade to the person's ability and the grade level) have the appropriate shape, then individuals with lesser ability would quit at a lower grade level than persons with a higher ability. Grade completed is a complete surrogate for ability.¹

Alternatively, assume we have a hierarchy of schools, from those for the most able to those for the least able. Assume that the schools only use a pass-fail system. Assume that the schools for the more able are more expensive. If individuals had perfect information about the capabilities (and ignoring motivation, emotional, and other problems) in fact no one need ever fail. Students would apply to the school of the appropriate ability.

It should be noted that all these self-selection devices are based on performance tests; that is, although the employer is using information from self-selection, self-selection only works because of the performance tests. If there were no possibility of failures, everyone would attempt to go to the best school (and then screening would have to be done by admissions committees) and everyone would pass on from grade to grade at the same rate.²

¹This is essentially the model discussed by Spence [19].

²This is, of course, not true of other self-selection mechanisms, e.g. those discussed by Salop. The absence of "performance tests" plays a crucial role in the economics of self-selection devices discussed by Akerlof [1] and Rothschild-Stiglitz [14].

Obviously, however, individuals do not have perfect knowledge of their abilities (and there may be a tendency on the part of some individuals to overestimate their abilities), and performance tests are imperfect, so some individuals who "should" have failed do not. If they do pass a higher school they get a higher wage than if they pass a lower school. They get a higher wage perhaps partly because they have learned more skills (the human capital model), but at least partly because they are "grouped" with higher marginal productivity individuals.¹ Their higher wage does not necessarily correspond to a higher social marginal productivity; more generally the amount by which their wage is greater than the individual of the same ability who has gone to the "lower" school or has been "screened out" of the upper school exceeds the difference in their social marginal productivities, i.e. private returns to education appear to exceed social returns.

7. The Structuring of Educational Systems

Although we have argued that an educational system inevitably provides some information about the capabilities of individuals, there are a number of characteristics of the school system which determine how much, and what kind of information is provided either by performance tests or by self-selection. The school system can decide on the fitness or courseness

¹ Throughout the discussion we take the extreme assumption that all information about individuals' abilities is obtained through the educational system, and hence the individuals' wages are determined by the label imposed by the schools. Obviously, there is some information obtained on the job. The qualitative results of our analysis will, however, be unaffected so long as (a) firms cannot obtain information on the job instantaneously and/or (b) there are any fixed costs of hiring and training.

screening.¹ The structure of payments for education² and the differences in "levels of education" provided by different schools are also important determinants of the effectiveness of self-screening.

Earlier, we noted that the reason that the school system was the major screening institution in our society is that this information is a natural byproduct of its principal activity of providing knowledge (skills) and guiding individuals into the right occupations. In most of the ensuing analysis, we shall employ a stronger hypothesis: the more educational institutions perform their principal function, the more screening that is produced as a byproduct.³ The more accurately it is able to place individuals into the right "slots" i.e., ascertains their comparative abilities the more accurately it must ascertain the individuals' absolute abilities. The more knowledge it attempts to impart, the more able it is to "separate out" the "men" from the boys. At the extreme, if it tried to teach nothing, there would be no basis for performance testing, and there would similarly be no basis on which the self-screening mechanisms could be based.

¹(i) At each grade level, it can decide simply to use a pass-fail system, or it can attempt to divide students into "A," "B," "C" categories.

(ii) It can decide that only a few students not pass on to the next grade level (a coarse system) or it can fail a large percentage of the students.

(iii) It can allow there to be only one "comprehensive" school or there can be different schools (or "streams") for individuals of differing abilities (some of which may be run privately or all may be run by the government).

²Thus programs like Yale's contingent repayment scheme reduce the efficacy of the self-screening mechanism, as David Bradford has pointed out to me.

³That is, for most of the analysis we shall assume that they are joint products, and that the mix between "screening" and "skill formation" is technologically determined. We could generalise the model to allow for the determination of this mix. In this paper we will not enquire in detail of how the skill acquisition and screening take place (e.g. the nature of the grading system). We shall employ a general formulation which is consistent with a number of alternative micro-structures.

There is thus the possibility that in imparting more skills to the more able students, we will simultaneously increase the inequality of income.¹ This has made the organization of the educational system, and the method by which the levels of screening and skill acquisition are determined, an intensely political question.

We argued above (pp. 8 ff.) that it may be possible, by appropriate tax policy, to offset the distributional effects of screening. These effects would be important, however, even if we were able to offset them completely. First, it is not likely that we would. Secondly, and more important, it is likely that in deciding on the level of education, certainly in a privately organized school system but even in a publicly organized school system, the decisions will not be made simultaneously with the structure of the tax system; that is, for instance, the voters in a public educational system are likely to take as given at the time they vote for their educational expenditures the degree of progressivity in the income tax. (This is particularly true where, as in the U.S., there are different governmental units involved.)

Many of the social issues involving education arise because of differences in the wealth of parents. It is important, however, to observe that this parental distributional question can, at least partly, be separated from the questions of educational organization on which we are focusing. Thus the government could provide its support for education in the form

¹This hypothesis is consistent with an assumption about the technology of learning which is the subject of some debate: that it is more efficient to impart information to homogeneous groups than heterogeneous groups. For the moment, we are ignoring distributional considerations: some individuals in the heterogeneous group may learn more than they would in a homogeneous group, but the total amount learned, i.e. the total increment in human capital, is larger when learning is conducted in homogeneous groups.

of vouchers, allowing individuals to use these in private schools.¹

Even if there were no inequality in parental ability to pay for education, there would be, as we have argued above, important distributional consequences to alternative methods of organizing the educational system. To isolate our attention on these, we shall assume in the subsequent discussion that an individual's attitude towards education is determined completely by the own private monetary returns.²

8. The Comprehensive School Systems with Majority Voting and Fairly Accurate Screening

In this section, we shall show under majority voting a comprehensive school system will, under reasonable assumptions, allocate too many resources to education (screening).

The model is a slight extension of that presented in Section 2. Individuals are described by a single characteristic θ ; the distribution of θ over the population is given by $h(\theta)$. We let λ denote the "intensity" of education. More intensive education (a) cost more, (b) screens better and (c) increases the productivity of the group educated, either because of skill acquisition or better matching of individuals and jobs.

¹A number of European countries have privately run publicly financed school systems.

²This would be the case for instance even without government redistribution if (a) there were a perfect capital market, (b) education was not a consumption good and (c) there were no tax distortions in the allocation of capital between human and physical capital.

The productivity effect. Let $p(\theta, \lambda)$ be the productivity of an individual of ability θ who has received an education of intensity λ . For simplicity, we shall let p take on the special form (upon appropriate choice of units)¹

$$(8.1) \quad p(\theta, \lambda) = m(\lambda)\theta, \quad m' \geq 0, \quad m'' \leq 0.$$

Screening. The educational system places labels on individuals; it gives a point estimate of the individual's ability. Let $e(\hat{\theta}, \theta, \lambda)$ be the probability that an individual of type θ be labelled $\hat{\theta}$, in an educational system of intensity λ . As λ increases, the probability of error decreases, i.e.

$$(8.2) \quad \frac{\partial e(\theta, \hat{\theta}, \lambda)}{\partial \lambda} \Big|_{\hat{\theta}=\theta} \geq 0.$$

Costs of education. Finally, we assume that the costs of education per pupil $c(\lambda)$ are an increasing function of λ and the marginal cost also increase with λ .

$$(8.3) \quad c' > 0 \quad \text{and} \quad c'' > 0.$$

In a comprehensive educational system all schools have the same value of λ . The model includes as special cases the traditional model of pure skill acquisition ($\partial e / \partial \lambda = 0$) and the pure screening model ($m' = 0$).

¹It should be noted that the model may be considerably generalized without affecting its qualitative properties. In particular, the restriction embodied in (eq. 8.1) may be dropped, and an additional kind of education, which increases skills without screening, may be introduced.

Wage determination. Workers whose ability is estimated to be $\hat{\theta}$ receive a wage equal to their mean marginal product

$$(8.4) \quad \hat{w}(\hat{\theta}) = m(\lambda) \int \theta e(\hat{\theta}, \theta, \lambda) h(\theta) d\theta / \int e(\hat{\theta}, \theta, \lambda) h(\theta) d\theta .$$

The expected wage which a person whose true ability is θ will receive, is then given by

$$(8.5) \quad W(\theta) \equiv \int \hat{w}(\hat{\theta}) e(\hat{\theta}, \theta, \lambda) d\hat{\theta} .$$

We shall consider a special case of a fairly accurate grading system, in which $e(\hat{\theta}, \theta, \lambda)$ takes on the special form

$$(8.6) \quad e(\hat{\theta}, \theta, \lambda) = f(\theta - \hat{\theta}, \lambda) = f(\epsilon, \lambda)$$

where

$$(8.7) \quad \epsilon = \theta - \hat{\theta}$$

is the error. We thus assume that the distribution of error is independent of the value of θ . Moreover, we assume

$$(8.8) \quad E\epsilon = 0$$

and

$$(8.9) \quad E\epsilon^2 = g(\lambda) .$$

Thus

$$(8.10) \quad w(\hat{\theta}) - m(\lambda)\hat{\theta} = \frac{m(\lambda) \int \epsilon f(\epsilon) h(\hat{\theta} + \epsilon)}{\int f(\epsilon) h(\hat{\theta} + \epsilon)}$$

$$\approx \frac{m(\lambda) h'(\hat{\theta}) g}{h}$$

and

$$W(\theta) = \int m(\lambda) \int \left[\hat{\theta} + \frac{h'(\hat{\theta})}{h(\hat{\theta})} g \right] f(\theta - \hat{\theta}) d\hat{\theta}$$

$$= \int \left[m(\lambda)(\theta - \epsilon) + m(\lambda) \frac{h'(\theta - \epsilon)}{h(\theta - \epsilon)} g \right] f(\epsilon) d\theta$$

$$(8.11) \quad \approx m(\lambda) \left[\theta + \frac{h'(\theta)}{h} g \right] \begin{matrix} > \\ < \end{matrix} m(\lambda)\theta \quad \text{as } h' \begin{matrix} > \\ < \end{matrix} 0 .$$

Thus in an unimodal distribution, individuals below the mode get more than they would under perfect screening, individuals above the mode get less than they would. The reason for this is that individuals are being averaged with some individuals who are better than they are, but have been underrated, and some who are worse, but who are overrated; if there are more who are worse (within a given range of error) than who are better, the individual will receive less than his true marginal productivity (on average).

Output maximizing educational intensity.

If we wish to maximize national output, less educational expenditures, in a comprehensive school system, i.e.

$$m(\lambda) \int \theta h(\theta) d\theta - c(\lambda)$$

we set

$$c'(\lambda) = \bar{\theta}_m'(\lambda)$$

where $\bar{\theta}$ is the mean level of ability in the economy.

Majority Voting

We now come to the choice of an educational intensity (and the associated degree of screening) in a majority voting political system. We assume the educational system is paid for by proportional wage taxes.

Then

$$(8.12) \quad \tau m(\lambda) \bar{\theta} = c(\lambda)$$

and

$$(8.13) \quad \begin{aligned} W(\theta)(1-\tau) &= m(\lambda) \left[\theta + \frac{h'}{h} g \right] \left(1 - \frac{c(\lambda)}{m(\lambda)\bar{\theta}} \right) \\ &= \left(\theta + \frac{h'}{h} g \right) \left(m(\lambda) - \frac{c(\lambda)}{\bar{\theta}} \right) . \end{aligned}$$

Taking the derivative of (8.13), we can see how varying educational intensity affects different groups

$$\frac{dW(1-\tau)}{d\lambda} = \frac{W}{m} \left(m' - \frac{c'}{\bar{\theta}} \right) + (1-\tau) m \frac{h'}{h} g' .$$

This depends on both θ and λ . Consider the optimal level of education. Note that then the first term drops out, and we are left with only the second term: individuals above the mode will want more than the optimal level of education, individuals below the mode will want less. It is possible to show that if $c'', g'' \geq 0$, and $m'' < 0$, preferences will be single peaked. Thus, the majority decision will be determined on the basis of the median value of h'/h . It is clear that if the mode lies below the median as it does for the income distribution there will be an excess of investment in education over the optimum amount.

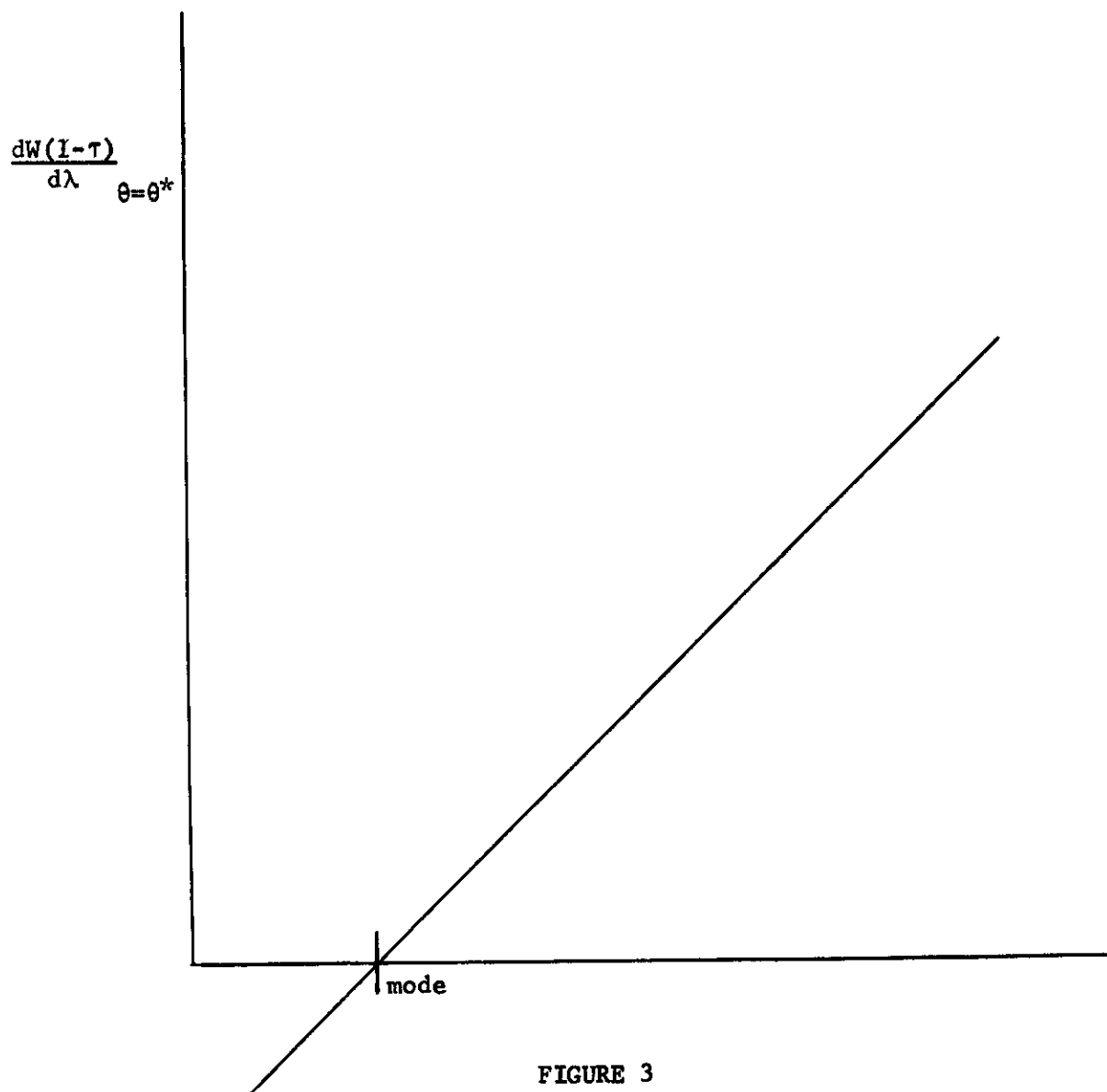


FIGURE 3

Indeed, it is easy to establish that not only is output lower, but the coefficient of variation in after tax expected wage incomes is greater, as illustrated in Figure 4 where $W^* = W(1-\tau)$.¹

It is worth noting at this point a major difference between fairly accurate screening systems and those in which, in the absence of screening, are very inaccurate. Take as an extreme case a system in which, with "no information" and no education everyone receives the average value of the marginal product, as discussed earlier. Assume education only screens and that the distribution of abilities is lognormal. With no screening, the median receives the average, with perfect screening he receives the median. As screening increases, his gross income declines. The cost of education increases (his tax payments) with screening, as depicted in Figure 5. Thus, there are two "peaks" to his net income, and accordingly there may not exist a majority voting equilibrium.²

1

$$EW^* = m(\lambda)\bar{\theta} - c(\lambda)$$

$$\begin{aligned} \sigma_{W^*}^2 &= E\left(\left(m(\lambda) - \frac{c}{\bar{\theta}}\right)(\theta - \bar{\theta}) + \left(m - \frac{c}{\bar{\theta}}\right)\frac{h'}{h}g\right)^2 \\ &\approx \left(m(\lambda) - \frac{c}{\bar{\theta}}\right)^2 (\sigma_{\theta}^2 - 2g) \end{aligned}$$

$$\frac{dEW^*}{d\lambda} = m'\bar{\theta} - c' \begin{cases} > 0 \\ < 0 \end{cases} \text{ as } \lambda \begin{cases} < \\ > \end{cases} \lambda^*$$

$$\frac{d\sigma_{W^*}/EW^*}{d\lambda} = \frac{-2g'}{(\sigma_{\theta}^2 - 2g)^{1/2}} > 0 .$$

²I am indebted to John Chant for discussions on these points.

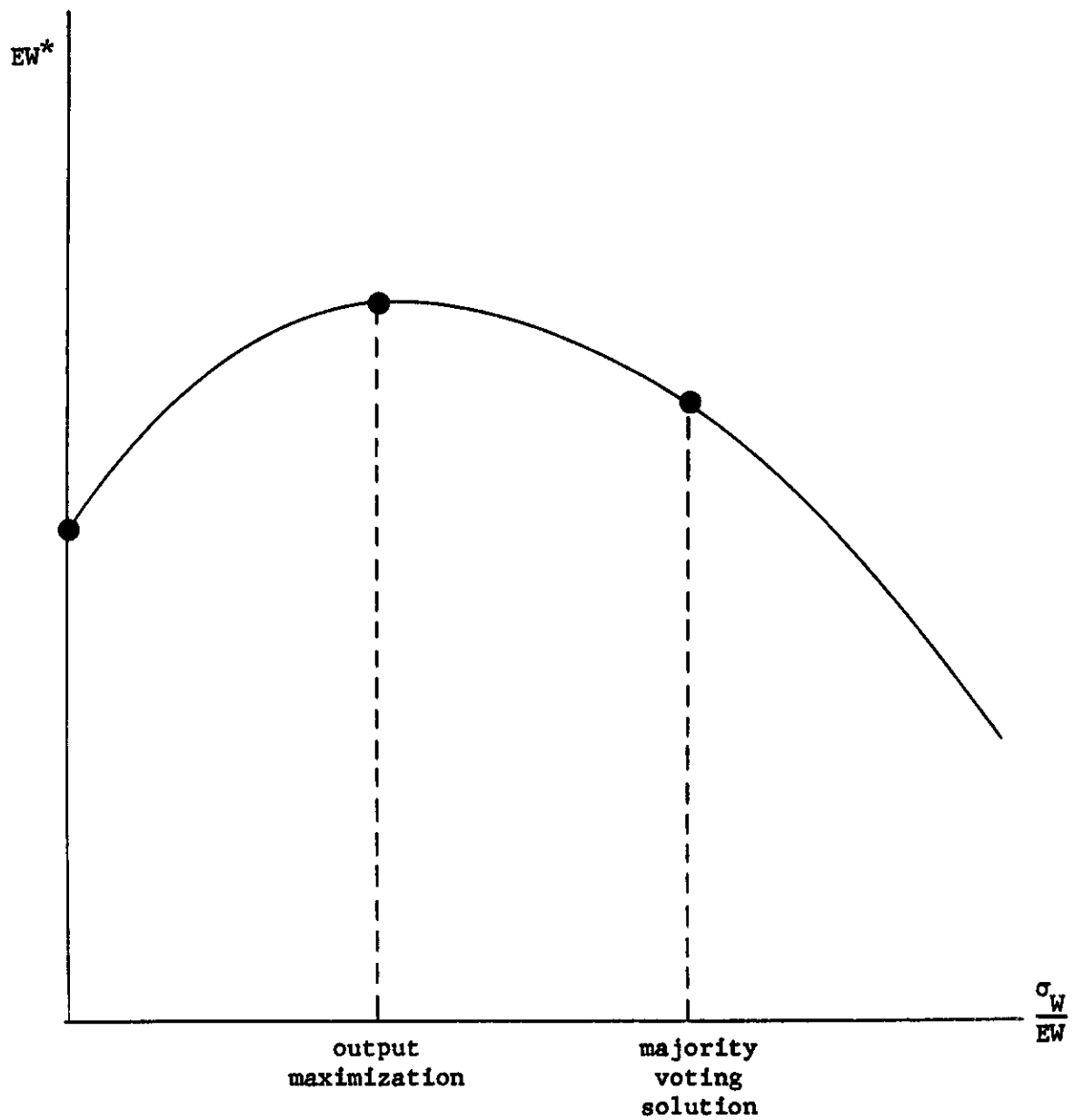


FIGURE 4

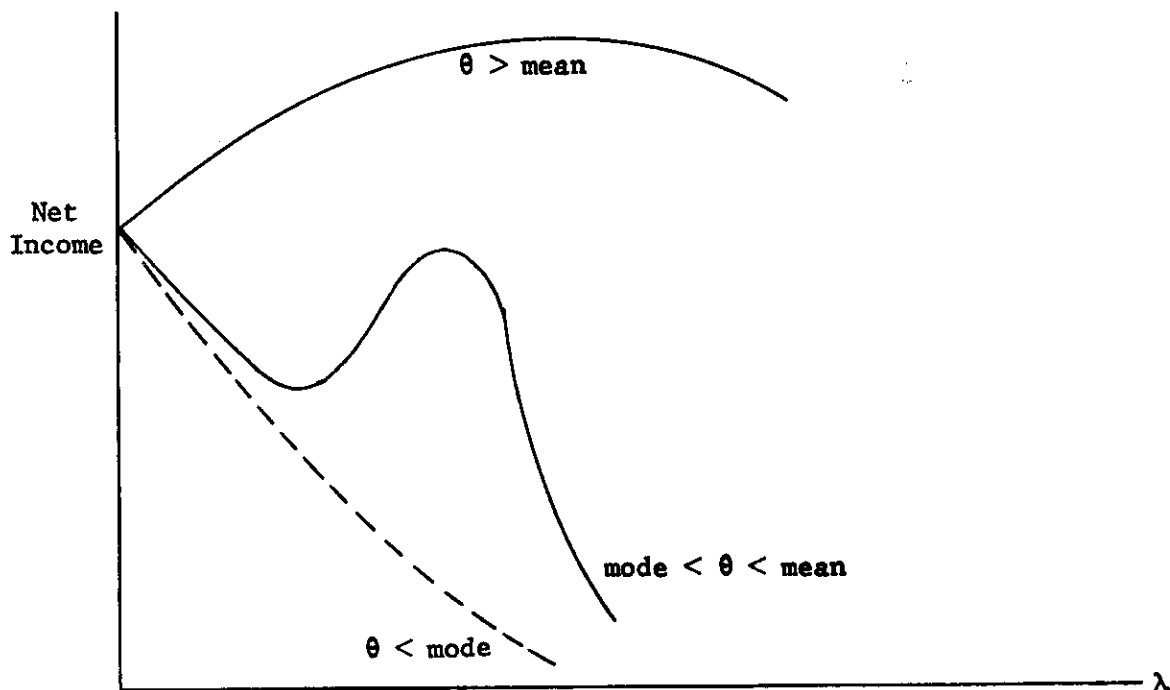
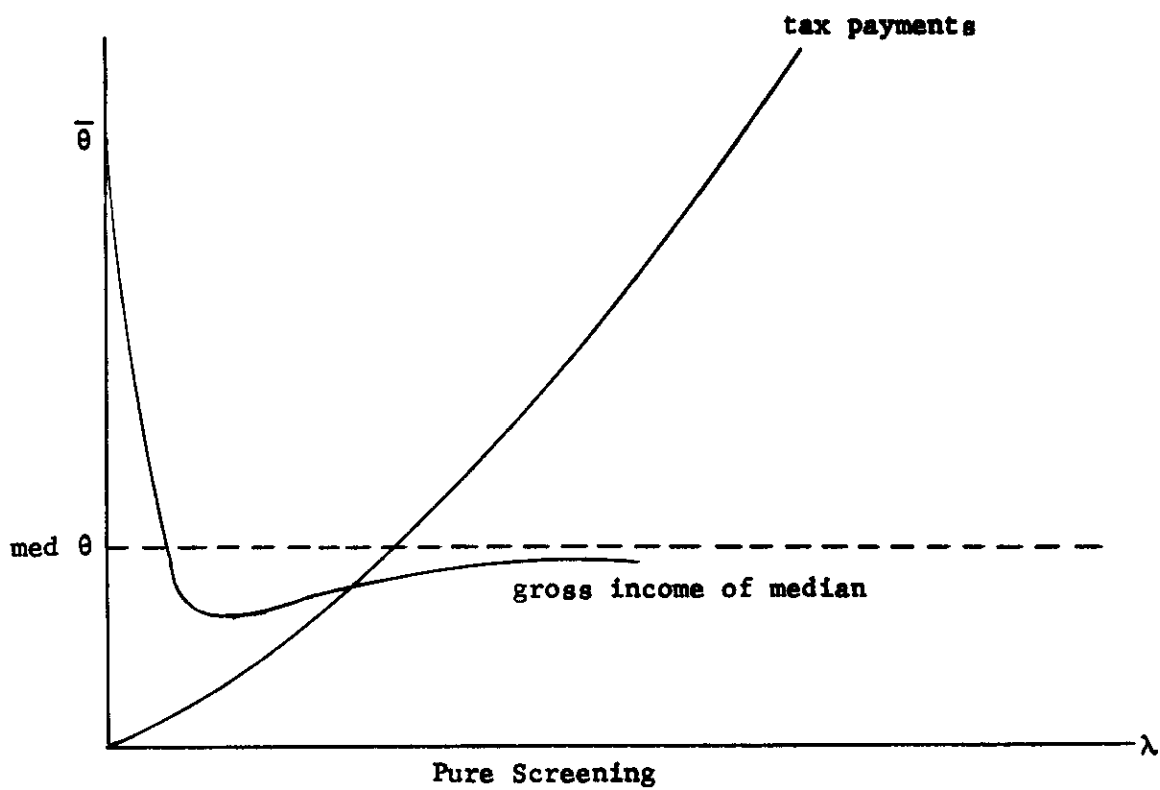


FIGURE 5

9. Non-Comprehensive School Systems¹

Although there is an institutional and analytical simplicity to a comprehensive school system, it is easy to establish that in general net national output is not as high as in a system in which different individuals receive different education. Indeed, if by greater ability we mean in part the ability to learn more easily, then it is more efficient (if our objective is maximizing net national output) to spend more resources on the more able. This will be a characteristic of most non-comprehensive school systems. The allocation, however, will differ between a governmentally organized one attempting to maximize net national output, a private educational system, and a mixed public-private system. The latter two will not maximize net national output. A full analysis would take us beyond the scope of this paper, but what we wish to do here is to characterize the major reasons that the equilibrium in pure private as well as mixed public-private systems does not maximize net national income. For simplicity, it is best to return to the special case of Section 2, where there are only two ability groups in the population; the school system will consist of two schools, one run by the more able, one by the less able; in the mixed public private school system, the school for the more able is private, the less able, public. Private schools charge a tuition equal to per pupil expenditure; public schools raise revenue by general proportional taxation.² Each school system will have some of both kinds

¹For a more extensive discussion of the issues discussed here as well as the development of a formal model, the reader is referred to "Education as a Screening Device and the Distribution of Income."

²We assume that the less able are in the majority.

of individuals, the upper school will contain some individuals of lower ability who are attempting the "gamble" of being able to pass through the system and hence be grouped with the more able, and those of lower ability who overestimate their ability. Conversely for the lower school.

Private School System

An increase in the intensity of education has three effects: (a) It increases the productivity of all workers; (b) it labels them more accurately; (c) it affects the efficacy of the "self-screening" mechanism. An increase in the expenditure on education of the upper school, with the lower school expenditure held constant, increases the risk of an individual of a lower ability going to the upper school since it lowers the probability that he will be misclassified with the more able;¹ its effects on more able students going to the lower school are ambiguous, but there is a strong presumption for an overall increase in the efficacy of self-screening.²

In the relevant region,³ an increase in expenditure in the lower school, λ_2 , lowers the efficacy of the self-screening mechanism.

¹Moreover, if he is classified as type 2 (lower type) he will have lost more (because of the higher tuition); somewhat offsetting this is the fact that if he is incorrectly classified as type 1 his net income will be higher than at the lower level of expenditure.

²On the one hand, it increases the costs if they are classified as type 2; on the other hand, it increases the probability of being correctly classified, and their income (through the productivity effect) if they are.

³That is, for levels of expenditure at least equal to that which would maximize per capita income of the lower group i.e. $\lambda_2 \geq \lambda_2^*$ where $m'(\lambda_2^*)\theta_2 = c'(\lambda_2^*)$. An increase in educational expenditures lowers the cost differential, and, at the same time, lowers the net return for an individual of type 2 to going to the lower school, since it increases the probability of being classified as a less able student and the increased productivity is less than the increased costs. On the other hand, because the educational differences are reduced while the probability of being correctly classified increased, more of type 1 individuals (the more able) will go to the lower school.

There are three misallocations in the private school system as compared to the net national output maximizing school system.

(a) The upper school overestimates the productivity effect (relative to the social return), the lower school underestimates it. The schools each look at the productivity effect on the wages of the individual of the "type" for which they are designed. The upper school ignores the "social loss" from the over expenditure on education of those (predominantly lower ability) individuals who attempt to go to the upper school, and conversely for the lower school.

(b) The direct returns to screening are all private, not social. This works in the opposite direction to (a), since in the upper school the private return to screening is positive, in the lower school negative. (The lower school may well design its educational programs to have little screening.)

(c) The social returns to self selection differ from private returns. The social returns result from being able to give each group the level of education appropriate to it. The marginal private returns are essentially of the same character as the private returns to direct screening. Thus the private returns to self screening for the lower school are negative even though the social returns are positive, which leads them to increase their expenditure on education over the optimal level. The relationship between private returns and social returns in the upper school is ambiguous, but if self-selection is working fairly well and direct screening is fairly accurate, and differences in "optimal levels" of educational expenditure with perfect pre-sorting are large, it can be shown that marginal social returns exceed private returns for the upper group as well.

These effects work in different directions: For the upper school, the productivity effect leads to overspending, the direct screening effect to overspending, the self-selection effect is ambiguous. If education were primarily a screening device, then since the productivity effect would be small, but the direct screening effect large, there would be over-expenditure. For the lower school, the self-selection effect leads to overspending, the productivity and direct screening effect to underspending. But as we argued above, since there are methods of organizing schools to reduce the direct screening effect, there is again a presumption for overspending, if the productivity effect is relatively small.

Mixed Public Private

The analysis for the mixed-public private school system is similar, except now the costs for the lower school are borne by the population as a whole. The direct effect of this is to provide a further incentive for over-expenditure by the lower school. There are, however, several indirect effects. Because the cost differential between going to public versus private schools is larger (than the cost differential between the upper and lower schools in the private system) at any given level fewer of the lower type students will attempt to go to the upper school, but more of the upper type students will go to the lower school. It is possible, although not necessarily the case, that the average ability level in both schools increases as a result. This means that the marginal private productivity return in both schools increases. Both the direct and the indirect effects lead to an increase in expenditure in the lower(public)school that is higher than in the corresponding private school (which we suggested, was in turn higher than the net national output maximizing level).

On the other hand, if educational expenditures are not tax deductible, the taxation of the returns to education lowers the private net marginal return and therefore acts to discourage expenditure on education in the private school. The consequences of the change in the self selection may either offset or augment this effect. The more effective self-selection increases the marginal productivity return but is likely to decrease the marginal return to screening.

More generally, since the expenditure in the public schools depends in part on the kind of program offered in the private schools, and conversely, it is easy to establish that, if each school takes the program of the other school as given, then there may exist multiple equilibria. There may be high level educational expenditure equilibria, where the private schools spend a great deal because the public schools do, and conversely, and there may be low educational expenditure equilibria. There also may be no equilibria. The presence of high quality private schools leads to high levels of expenditure in public schools, which essentially "compete away" the private schools. When there are no private schools "pulling up" the level of expenditure in the public schools, the level of public expenditure drops. This attracts in private schools, and the cycle begins again.

10. Concluding Comments

In recent years economists have shown an increasing awareness of "market failures" and have increasingly called upon government intervention to correct these failures. But to turn over an allocation process to the public sector is to make it subject to "political laws" which may

be no less forceful--and even less efficient--than the "economic laws" which previously governed the allocation process. The fact that these "political laws" are less well understood, perhaps more amorphous, than the corresponding economic laws is not an excuse for relying on the mythical "benevolent despot" who plays the central role in most economist's models of the public sector.

The educational sector provides an important point of comparison between the two allocation processes. If, as we have suggested, education provides information as well as skills, then it is providing a "commodity" for which it is well known that the market "fails"; we have shown how social returns differ from private returns and we have examined in detail the market allocation of resources to education as well as the structure of the educational system which would emerge from a simplified political process, in a highly idealized setting. Some important results emerge: "Efficiency" (maximization of net national product) will in general require that different amounts of educational resources be spent on different groups of individuals. In our model, efficiency required the expenditure of more resources on the more able than on the less able.¹ There will thus be a trade-off between efficiency and distributional considerations; but beyond a certain point, further increases in educational expenditure may both increase inequality and decrease net national income. We noted a tendency for all the school systems examined--public, private, and mixed--to operate

¹ Although the precise quantitative relationship clearly depends on the specific technological assumption embedded in equation (8.1) so long as some are able to learn more quickly and easily, than others, the result remains valid.

at these levels even when all citizens are simply concerned with income maximization. One of the reasons for this--found in all of the systems--is that some of the returns to higher levels of education, those returns derived from the increased accuracy of labelling individual's abilities, are private but not social returns; we argued that for the median voter if abilities are distributed skewly to the right, these private returns were positive. A further reason in publicly supported systems, is that the median voter pays for less than his proportionate share in marginal costs. As a result, the tendency for excessive spending on education is most marked in the publicly financed schools.

We noted in the private as well as the mixed-public private school systems an interdependence of the levels of education of one group on the levels of education of the other group. This interdependence has important implications, one of which we noted in the text: there may be multiple equilibria, i.e. because one group spends a great deal on education, the other group does, and conversely. Thus, although all the equilibria are likely to be "inefficient" (in that national income is not maximized), some may be worse than others. This interdependence also has important implications for the recent attempts to require uniformity of public educational

expenditure in different districts.¹ Education is more nearly a "pure" private good than it is a "pure" public good.² (The manner in which education is provided does of course have strong implications for the distribution of income, and indeed a strong public school system is one of the major methods by which we have maintained as much upward mobility as we have.) Demands for education differ markedly by different groups in the population. This is partly due to the differences in economic returns to education to different groups; it is also due to the fact that education is partly a consumption good, for which, like most other goods, there is a positive wealth elasticity of demand. If education were really a public good, this would have no consequence; those who would like less national defense consume the same level of national defense as those who would like more. But as we have asserted, education is primarily a private good, and the differences in demand are then important, so long as we allow there to be private schools. For the provision of a uniform level of education will reduce the level of "public" education offered to high demanders, increasing the relative attractiveness of private schools. Since parents whose students are in private school will have less interest in having public education, and since they were the "high" demanders in the initial

¹We are addressing ourselves not to the issue raised by the Serrano decision, which only equalized per pupil tax bases, but to the more fundamental issue of whether different school districts can spend different amounts per pupil. The argument applies to some extent within districts as well.

²Transportation costs result in their being some aspects of a "local public good"; these are not significant in metropolitan regions today, but they may have had much to do with the earlier development of public school systems.

situation, the level of education is likely to be lowered even further, thus encouraging more students to leave the public educational system. Not only is the consequence of an attempt to impose uniform expenditures on education a weakening of the public educational system, but it is even possible that it increase inequality, that is, the differences in expenditures on education of different groups and the amount of screening (including effective self-screening) may be even larger than at present.

A more detailed comparison of the various systems requires more detailed information about the various functions which play a role in the analysis: the productivity return to education, the screening function, the distribution of abilities, risk attitudes, and the accuracy of ones own estimates of ability. Moreover, we have limited ourselves to focusing on economic questions, and a complete comparison of the various systems would require an analysis of their social and political consequences.

What we have established, however, is that there appears to be no clear presumption, of the desirability on efficiency or on distributional grounds, of one of the systems we have examined over the others.

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