

The Education-Income Connection --

An Investigative Report

by

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ABSTRACT

This paper is a review of the literature on the subject of education and the distribution of income. The study was made with a special interest in the relationship as it exists in the developing countries. However, perhaps due to data problems, not much work (other than rate of return studies) has been done on these countries. Most of the theory, and empirical research, has been developed in the West. Consequently, much of the material covered in this paper may not have a direct reference to a developing country. But insofar as economic theory is universally applicable, this survey might help us in understanding the impact of educational policies in the developing countries.

The survey is arranged in the following manner: Section I is an introduction which attempts to set the issue of income inequality in a philosophical-political-economic perspective and Section II sets the stage for the study of the education-income connection. Sections III and IV discuss three theoretical models that have been offered to explain the distribution of income. These theories relate income inequality to education and as such their study is relevant for purposes of this paper. Section V connects theory and estimation and is concerned with the measurement of educational impact on income (rate of return analysis). Section VI discusses the income distribution effects of educational finance and Section VII makes a cautious attempt to evaluate issues concerning the intergenerational transfer of income and takes a dab at class mobility. Section VIII concludes the paper with a general discussion on the role of education.

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SECTION I - AN INTRODUCTION

The issue of income distribution is, at the risk of an understatement, a multi-dimensional one. Philosophy, politics and economics are inextricably involved in the determination of what the proper distribution of income should be and how should it, bliss, be achieved. This confluence of disciplines complicates the problem and makes difficult the search for unambiguous answers. Each field, however, has a unique contribution to make, and it is the purpose of this preamble to summarize, if possible, the important role each plays in any meaningful study of the problem of income distribution.

The issue has been particularly fascinating for the philosophers since the subject matter brings into possible conflict the notions of liberty and distributive justice. A noteworthy addition to the literature is a recent book by John Rawls [93], who delineates arguments for a program of social justice. The book has already set off a healthy discussion on its implications for policy (see Arrow [3], Bell [8]). Generally, philosophers have voiced concern over unequal starts in life, but have more or less accepted unequal results if these were due to factors like natural abilities and talents. (In terms of the framework of this paper, unequal incomes are acceptable, but only if they are a function of equal educational opportunity.) Rawls, however, contends that natural advantages are also random in character and therefore it is a myth to believe that there is equal opportunity. Consequently, one should concentrate on

equalizing results; and Rawls offers this recommendation for social policy:

"All social primary goods -- liberty and opportunity, income and wealth, and the bases of self respect -- are to be distributed equally unless an unequal distribution of any or all of these goods is to the advantage of the least favored."

Rawls program would favor only those programs which benefit the least advantaged absolutely, it is unclear as to how much relative inequality Rawls is willing to accept along with absolute improvement. Though this is perhaps not dealt with explicitly, it should be mentioned that there is a strong egalitarian bias in Rawls' writings.

Economists, particularly of the political kind, have also evinced a more than passing interest in the issue of income distribution. Their discussions on the subject, often spiced with passion and ideology, were inevitably (and some might say lamentably) calmed by the reason of positive economics. This reason dictated that a positive theory should accept the natural order of events and allow marginal products to fall where they may. Efficiency in the allocation of resources would thereby result and total wealth would be accordingly maximized. A further small step for these philosophers was the deduction that maximization of wealth would also maximize welfare. Needless to say, this ostensibly rational and positive approach was easily stripped of its veneer and exposed - and found to be as value laden as the prescription of its detractors.

Nevertheless, positive economics ruled, and the anguished voices from the left were muted, if not ridiculed. Protests against the structural bias of the system remained just that - and were sometimes dubbed by some to be the arguments of the heart, rather than of the mind.

Such was and is the hold of positive economics.

Lately, however, the discordant view is being tuned in by conventional economists. That the natural order of marginal products may not be just is slowly being accepted by economists, and the debate is now shifting ground from the question of income distribution to a search for answers to correct it.

This new approach is most obvious amongst the so-called development economists, who previous to the change recommended the maximization of growth formula. To understand their shedding of the growth skin one has to study the reality of the developing countries today. And to that issue we now turn.

The developing countries have always been poor, but the despair caused by poverty has now been exacerbated by tensions and rebellion over the prevailing distribution of wealth. The development decade of the '60's, dedicated to the single-minded pursuit of growth, has left in its wake some growth and worsening inequality. That this might be inherent to the growth process has been postulated by Kuznets and supported (and debated) by empirical research. (The worsening inequality is theorized to be the result of a shift from agricultural to non-agricultural sectors and from traditional to modern modes of production.) Kuznets theorizes that eventually a turning point is reached when the distribution becomes less unequal. He bases his theory on observations of the Western experience; it is never made explicit, however, as to when, and how, the turning point is reached.

Even if this point is reached, it is questionable whether the more destitute members of society will await patiently the day of judgment; whether, indeed, society in general can or should wait. Consequently, policy makers, international agencies and development economists have become increasingly concerned over the issue of income distribution. Indeed, the study of the subject has become trendy, though nobody doubts that its time had come. The progress report of the '60's, with its disturbing conclusions of some growth, worsening inequality and no absolute improvement in the lives of the least advantaged members of society has sent economists back to the drawing board for newer drafts of optimum policy. Where once the economists turned a blind eye to the issue of income distribution, in favor of the vision of bigger and better pies, there now is an avid interest in both growth and income distribution. Are there tradeoffs, and if so, how should the exchange take place?

It is indeed a welcome turn of events that even traditional economists are now talking about growth and income distribution. However, as one economist put it, all economic answers are ultimately political questions. Classes in power and the owners of wealth are usually loath to give up their prized possessions. Though growth and redistribution might now be theoretically possible, its practical possibility might be non-existent. The example of Chile is only too recent to remind us that even incremental changes within the prevailing political and social system may be unacceptable. Of course, it goes without saying that one person's incremental change / ^{may be} another's revolution.

To delve further into the political question would take us on a long detour. It need only be mentioned that the menu of policy choice consists not only of growth and redistribution and the tradeoffs, if any, between them but also the interaction and tradeoffs of these possibilities with political reality.

SECTION II - EDUCATION AND INCOME INEQUALITY

Coupled with the study of the implications of growth for patterns of income distribution is a complementary interest in the causal factors of income distributions. Marx, et.al. have, of course, extensively discussed this subject, but their preoccupation had been with factor incomes: returns to capital and returns to labor. Interest in causal factors of personal income distribution is relatively new and until quite recently, its explanation had been relegated to theories of chance. (See, for instance, Champerowne [27]). A resurgence of this view in a slightly disguised form is that of Jencks, et.al., [64] who state that a considerable variation in incomes is the result of luck.

The distribution of physical capital has always been recognized as having a bearing on the pattern of income distribution. However, another causal factor, education, though always recognized as an important determinant, has not been explicitly theorized until quite recently.¹ That education was always recognized as a determinant of income is revealed by this quote of McCulloch who said in his Principles of Political Economy (1825), that "a better system of education and a better law of inheritance are two of the most powerful means of reducing inequalities in income." (quote from Chiswick [29]).

What is the relationship between education and income? Between patterns of education and patterns of income? Interest in this issue is germane, and heightened by the fact that education is viewed by economists and policy makers alike as an instrument with a strong chance of achieving the target pattern of income distribution. And our purpose in this paper

is to examine this presumed education-income connection.

Though there is considerable interest in the education income relationship, its study (more so in the developing, than in developed countries) has been plagued with data problems. Often, there is no data available on the size distribution of income; if it is available, it may not exist in age-education-income form, something that is necessary for a meaningful study of the relationship. Even if these hurdles are overcome, there is the problem of consistency in the available data over time.

But the difficulties don't end here. There is the further problem of "measures." No standard measure of inequality exists. Amongst those proposed, and used, is the Gini index, the variance in the log of incomes, and the proportion of wealth owned by the top decile of the population. If measures cannot be agreed on, how can we talk about changes in inequality? What if different measures show changes in different directions? In this paper, we will abstract from questions of measurement. It will be assumed that, however defined, an acceptable measure of inequality exists.

With that assumption behind us, we can now begin to talk about the relationship between education and income. But before we do so, one final caveat. In the discussions on the impact of education on income, the difference between absolute betterment and relative improvement should always be kept in mind. More education might indeed make an individual better off, both absolutely and relatively, if only he receives the extra education. (This has been extensively "proved" by rate of return studies about which more will be said later.) However, it is a moot question whether a more equal pattern of education will lead to a

more equal distribution of income. The difference is between marginal and average changes. It is the issue of overall changes in education and their impact on income inequality which is the primary concern of this paper; though, of course, the study of the marginal impact of education is of relevance to the study of the impact of average changes.

In the next section, we begin to examine the theories that have been offered to explain the patterns of income distribution. We will first look at human capital theory, which incidentally is the only theory that explicitly explains income differences through differences in educational investment. Next, Tinkergens analysis of income distribution within a supply-demand framework will be examined and the discussion will be concluded with a look at the Thurow-Lucas job competition view of the labor market. Let us begin.

SECTION III - HUMAN CAPITAL THEORY

"The rise in the investment in education relative to that invested in nonhuman capital increases total earnings relative to total property income, and property income is distributed much less equally than the earnings of persons from labor. Therefore, investment in schooling reduces the inequality in the distribution of personal incomes," T.W. Schultz ([99], p. 177).

Mincer, in a recent article [82], has come out with an excellent survey of human capital theory. The interested reader is referred to it for more detail — here we shall summarize aspects of the literature more relevant for our discussion.

The definition of human capital is a useful place to start. The term "human capital," not surprisingly, is itself indicative of its nature. Capital can loosely be defined as anything which, produced at a cost (though sometimes it may fall as a manna from heaven) provides services through time. The amount of such services per unit time is the return on the investment (production at cost). If such a 'thing' is embodied in human form, then it is referred to as human capital. The obvious difference between this form of capital and its more traditional cousin, physical capital, is that the latter, embodied in a material form, can be sold, whereas the former can only be rented. (We are assuming that slavery is outdated.)

And how can an individual aspire to possess this form of capital? In principle, by indulging in any activity that will increase his productivity. And conventional wisdom has it that education is exactly such an

activity. (Another important form of human capital generation is on-the-job training and/or experience.) The connection between education and income is now apparent. The basic source of differences in earnings is the variability of the educational investment undertaken by the individuals. If education has a cost and a positive rate of return, then differences in earnings are a reflection of this investment; and in a competitive equilibrium, the distribution of earnings will be such as would equalize the present value of future earnings, appropriately discounted, at the time investment takes place.

After this brief, and admittedly oversimplified exposition, let us examine in somewhat more detail the essential aspects of human capital theory. There are, in the main, two important parts to the theory: one which purports to explain differences in the level of earnings and the other which attempts to explain differences in the variances of earnings (across regions, countries, etc.). Obviously, the two are intimately related, as it is hoped will be made clear by the development of the analysis.

The formal model through which educational investments result in increased income is presented in Appendix I; here, only the 'final' equation is reported. It is:

$$\ln Y_i = \ln Y_0 + \bar{r} S_i + U_i \dots\dots\dots(1)$$

- where
- Y_i = earnings of individual i with S_i units of schooling
 - Y_0 = earnings of an individual with no investment in human capital
 - \bar{r} = average rate of return from a unit of schooling
 - S_i = amount of schooling undertaken by individual i
 - U_i = residual - incorporates other determinants of earnings.

What does equation (1) tell us, and what are its implications? Apart from the conventional assumptions of perfect competition (so wages can be taken as a proxy for marginal productivity for purposes of estimation), the model assumes:

(a) no differences in ability amongst individuals; (b) all levels of schooling have the same rate of return (c) earnings are totally attributable to schooling and no other factors and (d) it is only quantity of schooling that matters, not quality.

Obviously these are a very restrictive set of assumptions, but if it is assumed that factors like quality of schooling, ability, etc., enter multiplicatively in the earnings function (Appendix 1) or additively in logarithmic form in equation (1), the model can incorporate these details within its basic framework.

Considerable research in the area of human capital has been devoted to the incorporation of these other determinants of earnings into the basic equation, so as to obtain a truer estimate of r the internal rate of return to schooling. To the extent these other factors are excluded due to measurement problems and the like, estimation of r will lead to a biased estimate, and the direction of the bias would depend on the presence and nature of collinearity between it and the omitted variables. Since most often the other determinants of earnings (family background, innate ability, intelligence) are positively related to schooling, a specification error will generally lead to an upwardly biased estimate of r . How the model can be expanded and the manner in which additional variables can be entered, is shown in Appendix I (b).

is

Equation (1)/the basic human capital model of earnings. This model, by itself, was found by Chiswick [33] to explain between 17-51% of the differences in earnings for the states of the U.S. It was mentioned earlier that on-the-job training and/or experience was an important human capital generating activity. This factor can, with certain assumptions, be easily inserted in equation (1) for empirical research. If A is age of individual, T the amount of post-school training and S the amount of schooling, then $A = T + S + 5$ or $T = A - S - 5$. If r' is the rate of return to post-school investment, then equation (1) becomes

$$\ln Y_i = \ln Y_0 + r_i S_i + r'_i (A_i - S_i - 5) + U_i \quad (2)$$

or, with rearrangement,

$$\ln Y_i = (\ln Y_0 - r_i \cdot 5) + (r_i - r'_i) S_i + r'_i A_i + U_i \quad (2')$$

Recently, the human capital model of earnings has been extended by Mincer [83] to allow for the important effect of employment on earnings.² In effect, equations (1) and (2) assume full employment of the worker during the year. If employment (weeks worked) and earnings (weekly wages) were independent of each other, then there would be no need for modification of the basic model. However, there are both economic theory and human capital reasons (it is not implied that the latter does not incorporate the former) for expecting a relationship between employment and earnings; some of these reasons will now be examined.

If some employment were seasonal, then one would expect higher weekly wages, ceteris paribus, for those with less employment possibilities -- this to compensate equal workers for the less than full-time opportunity of employment. A backward bending supply curve of labor would also

dictate that weekly wages be inversely related to the amount of weeks worked per year.

But to the extent that the supply curve of labor is upward sloping, with the price effect of the higher wage exceeding the income effect, a positive relationship is predicted between weekly wages and weeks worked. Higher weekly wages can, of course, be a function of both human capital investment and other factors (ability, luck, discrimination, etc.). There is another, human capital specific reason for expecting the positive relationship mentioned above. And the reason is the differential impact of training that is specific and that which is general to the firm.

General training is of a kind that can be applied to all firms. A worker possessing only general training is paid his marginal product - the value to the firm is the workers wage. During recessions and the like, the value to the firm of a worker declines, the marginal product goes below the wage and layoffs result. With specific training, however, there is no longer the equivalence that one obtained before between the marginal product and wage of the worker. Now, the value to the firm of a specific trained worker is likely to exceed the cost to the firm - the wage of the worker. And this wage is likely to exceed the worker's opportunity cost i.e., wage of a worker with only general training. Due to this wedge between value to the firm and the workers marginal product, a decline in output may not lead to disemployment, since the value to the firm, while declining, may still exceed the wage of the worker. Also, quit rates for specific trained workers are expected to be less - their wage exceeds their opportunity cost.

If one now makes the plausible assumption that those with more investment in human capital also indulge in or are able to receive more specific training, then a direct link is observed between human capital, earnings and employment i.e., ceteris paribus, those with greater human capital have more specific training, higher weekly wages and work a greater fraction of weeks during a year.

It remains to introduce in a suitable fashion, the variable, weeks worked, in the human capital equation. If γ is defined as the elasticity of annual earnings with respect to the fraction of weeks worked during the year, then the earnings equation (2) becomes:

$$\ln Y_i = \ln Y_0 + r_i S_i + r_i' T + \gamma \ln(ww) + U_i \quad (3)$$

where ww = weeks worked during the year.

If U_i is assumed to be a random variable, equation (3) is in a form which can be estimated. γ has been found by Mincer [33] to be 1.17 for the U.S. (1960 data), and to be significantly different than unity. Backward bending supply curves and seasonal employment predict γ to be greater than zero but less than 1. Human capital theory and upward sloping supply curves predict γ to be greater than unity.

SECTION III (b) - EARNINGS INEQUALITY ACROSS REGIONS -
THE HUMAN CAPITAL VIEW

The discussion so far has dealt with the specification of the human capital model to explain differences in earnings. It will now be extended to explain variations in income inequality across regions via human capital considerations.

Before one can discuss differences in inequality, an acceptable measure of inequality must be agreed upon. The variance of the log of incomes is one measure of dispersion. To the extent income distributions are positively skewed, the log normal distribution may be a better approximation than others. Two other advantages are mentioned for the use of this measure of dispersion. Firstly, it is devoid of units and so can be used for international comparisons, and secondly, the variance of the log of income is unaffected by absolute changes in inequality whereas, for example, the variance of incomes is (for instance, if all prices and incomes doubled, the variance in logs would remain unchanged; the variance in income, however, would quadruple). There are other measures that can satisfy the criteria set out above; what argues especially for the variance in logs is the formulation of the human capital model. Since data on dollar investments are scarce, the human capital model, as shown above, is estimated in terms of years of schooling completed. If one takes the variance of both sides of equation (1), it is the variance of the log of income which is related to the variance in years of schooling, training, etc. Availability of data of the latter kind, rather than dollar investments argues for using the variance in the log of incomes as a measure of dispersion.

Equation (1) of the human capital model is

$$\ln Y_i = \ln Y_0 + r_i S_i + U_i \quad (1)$$

If one takes the variance of both sides, assumes $\ln Y_0$ to be constant across individuals and neglects differences across individuals in the residual U_i , then

$$\text{var} (\ln Y_i) = \text{var} (r_i S_i) \quad (4)$$

If one further assumes that \bar{r}_i (average rate of return to individual i) and S_i (amount of schooling undertaken by individual i) are distributed independently, then³

$$\sigma^2 = \text{var} (r_i S_i) = \bar{r}^2 \text{var} (S_i) + \bar{S}^2 (\text{var} r_i) = \text{var} (r_i) \text{var} (S_i) \quad (5)$$

where

σ^2 = variance in the log of incomes

r = rate of return to schooling; \bar{r} = average

S = amount of schooling; \bar{S} = average

An important assumption for equation (5) to be true is that r and S be distributed independently. Chiswick [33] offers reasons to justify this assumption. Briefly, his argument is as follows: for a given level of wealth, those with higher marginal rates of return from schooling have an incentive to invest more in schooling. For a given level of ability, those with greater wealth have a greater incentive to invest and receive a lower marginal return. (This is explained in terms of Becker's analysis, pg.22) If wealth and ability are positively correlated, the relationship between marginal and average rates of return and level of schooling is ambiguous and an independence assumption is plausible.

Equation (5) is the basic form of the human capital model relating to variances of earnings. With other assumptions, Equations (2) and (3) of the model can also be suitably transformed and a new equation explaining differences in earnings obtained accordingly. (Chiswick [33] and Chiswick and Mincer [34] have done this for the U.S. and its states.) For our purposes, it is sufficient to consider Equation (5) and the more sophisticated version of the model will not be considered.

Though data difficulties might prevent an empirical investigation of Equation (5), (data on individual levels and inequality in rates of return are difficult to come by), the model is nevertheless useful for qualitative conclusions. In order to prevent confusion, let me reiterate that Equation (5) is a model to explain relative inequality in income across regions i.e., it is useful for comparing effects of education or human capital investments on the inequality of income across regions or countries rather than across individuals.

Let us begin our qualitative exploration of equation (5) with an examination of two polar cases.

(a) assume $\text{var}(S) = 0$ which would mean equal educational achievement and

(b) $\text{var}(r) = 0$, which would mean that people have equal ability (if differences in r are assumed to reflect only differences in ability).

$$\text{Case (a): } \text{var}(\text{Ln}(Y)) = \frac{2}{\bar{s}} \text{var}(r) \quad (\text{var}(s) = 0)$$

i.e., if education is made equal, earnings are more unequal at higher levels of equal schooling, and

Case (b): $\text{var}(\ln(Y)) = r^2 \text{var}(S)$, $(\text{var}(r) = 0)$

i.e., differences in schooling create greater differences in earnings at higher levels of ability.

Apart from these results, examination of equation (2) also suggest that earnings inequality is a rising function of

- (1) The inequality in investment in training and its average level and
- (2) The inequality in investment in the rates of return and their average level.

But these are ceteris paribus conclusions. Can the model tell us anything about the effects on income inequality of changes in the distribution of schooling and growth in income? Yes, it can, and it has been used for precisely such purposes by Chiswick [29,30,31].

The basic approach in these articles is to apply economically reasoned assumptions to the relationship between r , S , and other variables (ability, access to funds, development, etc.) and then deriving conclusions.

In [29], Chiswick examines the effect on the distribution of income of minimum school legislation laws (they increase the level, but decrease the variance of schooling and income), the impact of human capital investment on the skewness of earnings [30], (effect is positive and significant) and the relationship between education, economic development and income distribution [31]. This relationship can only be investigated in a general equilibrium framework since the effect of development on the rate of return is not clear a priori. With development, decreased variance

in training implies a decline in inequality; however, the direction of change in the level and variance of the rate of return is ambiguous and dependent on supply demand factors, access to funds, nature of technical change and the rate of growth of income etc. (Carnoy [23], for instance, found rates of return from schooling to be positively related to the rate of growth of income, though not correlated with the level of income)

Al-Samarrie & Miller [2], in their article for the U.S., conclude that the level of education is highly (inversely) correlated with income concentration. Chiswick [28], however, speculates that this simple correlation is misleading; that the level of education is positively related to income inequality, ceteris paribus, and that Al-Samarrie & Miller get the results they do because their simple correlation is a net effect and includes the impact of two omitted variables -- the average rate of return and the variance of schooling.

This example shows the partial and general character of the analysis of the impact of education on income distribution. There are interdependencies involved and it is difficult to reach conclusions, a priori. The human capital model does not provide definite answers to the question of educational impact on income inequality in a general equilibrium framework. However, it provides a manageable and useful framework for analysis.

Before we end this discussion of the human capital model, it might be useful to look at a common conception of the role of education -- that a more equal pattern of education should lead to a more equal distribution of labor earnings.

Let labor earnings (w) be a function of returns to pure labor (p) and human capital (h), then

$$w = p + h$$

If it is assumed that returns to pure labor (p) is constant across individuals, then

$$\text{var } (w) = \text{var } (h)$$

or

$$\frac{\text{var } (w)}{\bar{w}} = \frac{\text{var } (h)}{\bar{h}} \cdot \frac{\bar{h}}{\bar{w}},$$

where \bar{w} and \bar{h} are the respective averages. As educational investment increases, $\text{var } (h)$ will decline, though \bar{h}/\bar{w} will increase as returns to human capital form an increasing proportion of total earnings. Thus, a decline in the variability of education may be accompanied with a rise in the coefficient of determination (variance/mean) of earnings. Eventually, however, earnings should begin to show an equalizing trend, (in terms of a decline in the coefficient of determination).

Thurow and Lucas [109] have challenged the empirical basis of this theoretically plausible model. In particular, they argue that U.S. incomes haven't shown this equalizing trend even though there has been a substantial change in the distribution of education within the last 30 years. Of course, it can be argued that an even more equal pattern of education is needed before equalization is observed, but almost zero change within the last thirty years makes one skeptical of this hypothesis.

If education was the only variable of the human capital model, then the objection of Thurow-Lucas would hold. Indeed, a recent article

by two human capitalists, Chiswick and Mincer [34] also concluded that the distribution of income had changed little in the U.S. since 1939. A human capital model, however, was successfully used to explain the distribution of income (adjusted coefficient of determination = 87%). But most of the explanation, almost half, in income variation is accounted for by the new human capital variable—weeks worked. (see p. 12). It is this factor which is used by the human capitalists to explain the paradoxical no change in income distribution with significant changes in educational distribution.

Chiswick [33] has used the basic schooling model (without the employment variable) to explain regional differences in the dispersion of income of the states of the U.S. and Canada. He found that differences in the average rate of return and inequality of schooling can explain about 60% of the differences in the inequality of incomes. Education, thus, may have an equalizing impact as observed from cross section data, though time series behavior may not show this effect.

preceding

The/discussion of the human capital model has dealt with the relationship between education and income in aggregate terms.

Before we take leave of the human capital model, it might be useful to look at investment in education at a micro level i.e., what individual decisions and factors cause the pattern of investment in education to be what it is.

SECTION III. (c) - THE PRIVATE DEMAND FOR EDUCATION 'A LA BECKER

A model to explain the amount of investment undertaken by an individual has been developed by Becker [5]. In his model, earnings are viewed as a reflection of investment in human capital (education) and the amount of such investment undertaken is revealed by an individual's supply and demand curves for education. [See Fig. 1].

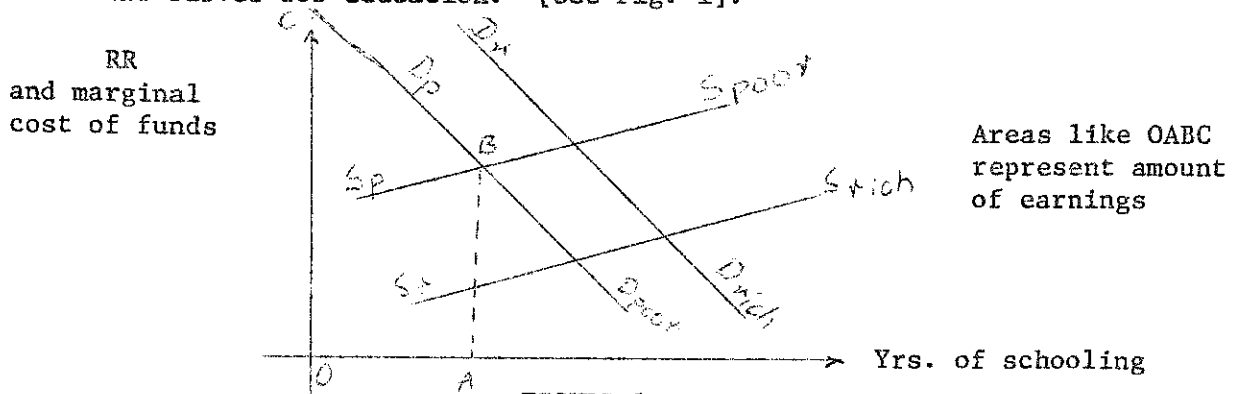


FIGURE 1

The demand curve represents the marginal rate of return on increasing amounts of education. It is postulated to slope downwards because of diminishing returns which set in because of: (a) rise in opportunity costs with additional schooling (b) finiteness of an individual's life in which returns can be recouped (c) diminishing returns to scale due to limited capacity of the human mind and (d) uncertainty about future benefits coupled with increasing marginal risk aversion as more capital is accumulated.

The supply curve, being a reflection of access to finance slopes upward for the usual reasons (increasing marginal cost of additional finance). The intersection of the two curves gives the optimum amount of investment to be indulged in.

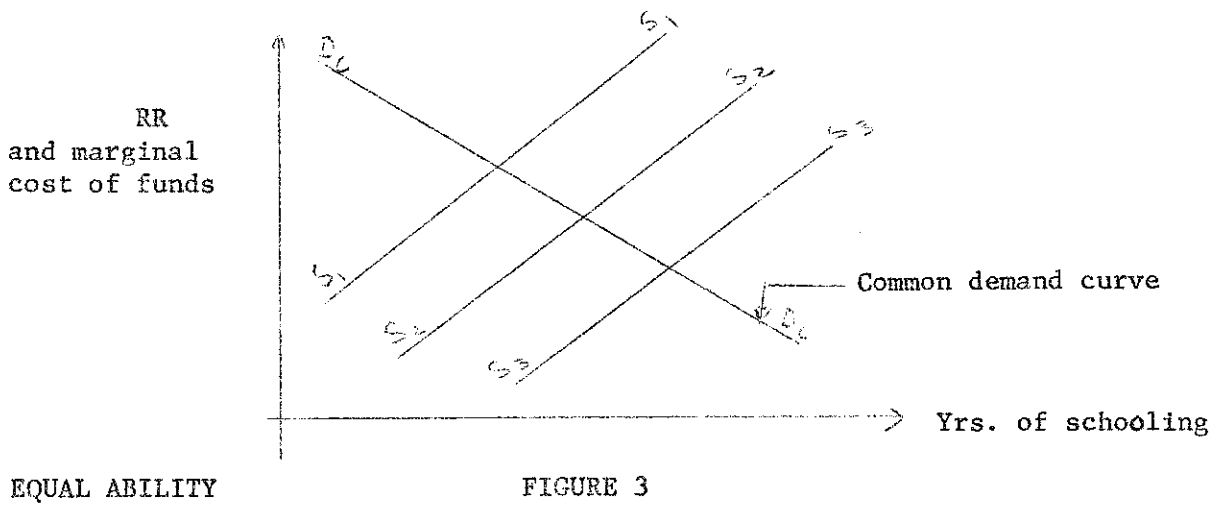
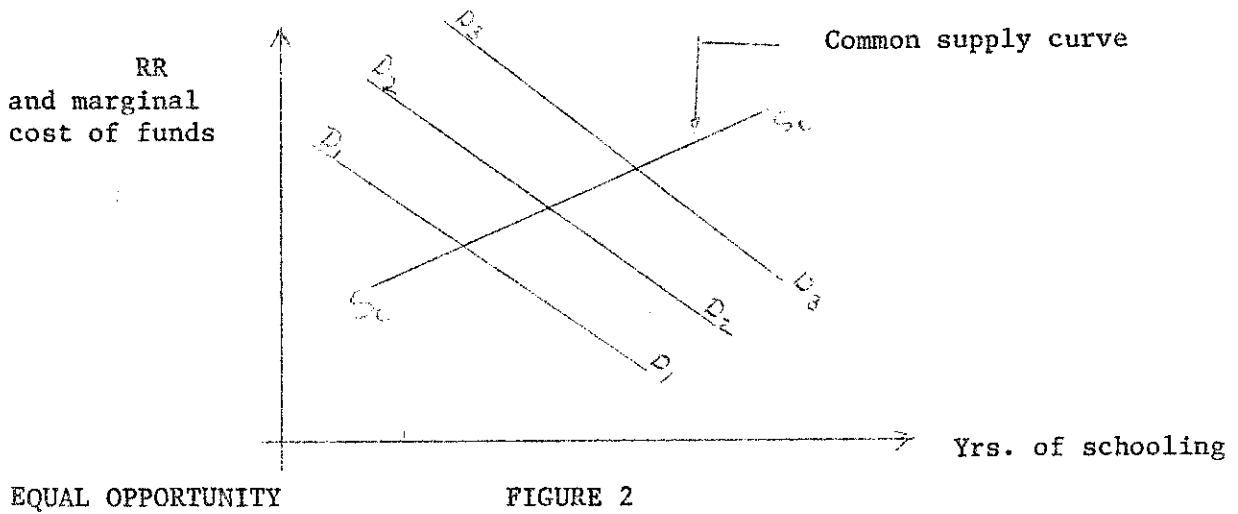
Differences in individuals are reflected through differences in levels of their demand and supply curves. Able persons, for instance, would

have their demand curves shifted outward (more returns for same amount of schooling), whereas richer persons would have their supply curves shifted rightward (lower marginal costs of borrowing.)

With Becker's approach, one can study the same variables as mentioned in econometric analysis; only here it is done in the framework of supply-demand analysis for each individual. Thus, rather than estimating the average rate of return as in econometric estimation, one can show the variance in it across individuals with the help of Becker's model. Also, one can see why differences occur in human capital investments across individuals. Both ability and access to funds play separate roles in this process. More able persons have higher demand curves and so indulge more in training for a common supply curve (and thus have higher earnings); wealthier persons have lower supply curves, and therefore undertake more training for a common supply curve (and thus have higher earnings.)

Convenient and useful as this model is, there is one major problem with it. And that is the possible fact that the shapes of the demand curves may be systematically related to the manner of educational finance i.e., the shapes of the supply curves.⁴ Becker's model assumes that the demand curve for a particular individual is given; whereas, in general equilibrium terms, it is quite clear that the demand curve will be affected by supply considerations. [If more than a marginal amount of extra college graduates enter the market, it will depress the wage, and therefore the rate of return to college education.] The equilibrium price of education is therefore determined within a simultaneous framework; and the partial model is consequently incomplete for general conclusions.

The model is also quite useful for deriving results, under certain assumptions, of the impact of educational investment on earnings distributions. Implications of an equality of opportunity policy (a common supply curve) and equality of ability (a common demand curve) can be deduced. [See Figs. 2 and 3] The former would give a distribution of earnings according to the distribution of ability whereas the latter would reflect the distribution according to access to capital.



In the general case, however, the world is more complex and the two curves may be systematically related for the individuals. Richer people are more able and have lower marginal costs of funds. Implications about educational policies can be derived from the assumption one makes of the relationship between these curves. If not much correlation is assumed between ability and wealth, then a reduction in inequality of opportunity (smaller variance in the supply curves) is likely to lead to a greater equality of earnings. This result would occur because we would now have just a variance in ability, unskewed by the correlation between ability and opportunity.

But, as Reder [94] points out, this is not self-evident. "....a further analytical consideration, and one with considerable practical importance, complicates the relation between unequal access to training and unequal earnings. The marginal return imputable to native talent relative to that imputable to training, will surely vary as investment in training becomes greater and more widespread. As appropriately trained persons become more abundant, jobs which have paid well heretofore because of the great training required, but which require little native talent, will decline in relative power to those requiring greater degrees of native talent. If it should happen that those individuals who initially received more training, because of easier access, should also have more native talent than others, then the effect of equalizing access to training might increase the dispersion of earnings and not the reverse. That is, as the relative advantage (of the initial high earners) from greater training diminishes, their earning advantage from greater native ability may increase sufficiently (because of its increased scarcity relative to investment in training) to give on balance the effect of

a more unequal distribution of earnings."

Apart from the modifications that have to be introduced into the analysis because of considerations of variance in natural abilities etc., the human capital model suffers from another major shortcoming. The theory is too much a supply side view of the world and demand considerations, though mentioned, are ignored in the analysis. In the next section, two alternative models of income distribution will be discussed; both of these explicitly account for supply and demand considerations in the income determination process.

SECTION IV (a) - THE TINBERGEN MODEL

The second model of earnings inequality that will be discussed is one developed by Tinbergen [110]. His model has appeal because it possesses economic virtues --- demand-supply analysis of wage determination and maximization of utility on the part of the workers. This points out the weakness of the human capital model which proceeds according to the maximization of present value, which, by itself, has no foundation as a behavioral assumption --- unless, of course, maximization of present value is assumed to imply a maximization of utility.

Another difference between the Tinbergen model and that of the human capitalists is that the former explicitly introduces the "demand by the organizers of production for skill or qualification alongside with supply," whereas the latter mentions the demand side but ignores it in the analysis.

Labor incomes in the Tinbergen model are determined by demand-supply considerations. Occupations are chosen (and skills invested in accordingly) by individuals for the purpose of maximizing utility. And utility is presumed to be a function of three variables: (a) consumable income (b) psychic (or indirect i.e., not concerned with income) benefits, and costs, involved with the occupation and (c) the difference, or tension, between the required and supplied qualification of the individual for the job. The last mentioned consideration always has a negative impact on utility, regardless of its direction; people feel harried and insecure in a job above their qualifications and have to be compensated; over-qualified people also have to be compensated for working beneath capacity.

An immediate advantage of this kind of supply formulation can be noted. The question of psychic attributes of an educational level or occupation has been relatively ignored by economists, perhaps due to the quantification problem involved. (Something, we might note, Tinbergen also has to face with in his empirical work.) Nevertheless, it, psychic attributes, are an important determinant of occupational choice and should be explicitly theorized and accounted for, if possible. (It is this attribute of jobs that can allow, in Tinbergen's model, an equality of incomes without an equality of skills, native or otherwise.)

The demand side is a representation of a set of attributes associated with a job; these attributes indicate the nature of the job and its requirements. Education, though perhaps the most important one (and the only one in econometric estimation), is only one of a set of requirements for a job. The amount and kind of demand exerted by the producers is dictated by the usual considerations - technology of production, prices of factors, etc.

The stage is now set for income (wage) determination. Suppliers and demanders of a vector of attributes enter the market place which acts as a match maker for the two distributions. The differences in the two distributions (supply and demand attributes) give rise to what Tinbergen calls "tension." And it is this element of tension which determines differential incomes - in general, high incomes are paid for qualifications which show a high tension and low incomes to those which show a low or even negative tension (supply exceeds demand). Given this framework, it follows that incomes could become equalized if there was

no tension between the two distributions. "People would not need to be of equal productive quality in order to attain this near equality of incomes."

Though an eminently satisfying theoretical proposition, the Tinbergen model becomes encroached by difficulties in empirical verification. Skill attributes, previously a set of general characteristics are now reduced to a single variable - number of years of schooling. And to represent demand, Tinbergen resorts to a fixed-coefficient approach; his index of demand is a measure weighted by the percentage of third level manpower in existing jobs. Given these assumptions, Tinbergen proceeds to estimate his model, and in particular, to determine the impact of education on income [111].

If inequality is determined by differences in tensions, then the model can be represented by the following equation:

$$X^{10} = \alpha_1 (D_1 - S_1) + \alpha_2 (D_2 - S_2) + 1 + U,$$

where

X^{10} indicator of inequality (a ratio of upper decile income/average income)

$D_1 - S_1$ difference in demand-supply of university graduates

$D_2 - S_2$ difference in demand-supply of non-university graduates

1 value of inequality when there is no tension i.e., upper decile income is equal to average income

U residual; incorporates other variables, etc.

Estimation of the model for Netherlands data gives the correct (positive) signs to the coefficients α_1 and α_2 . What is interesting for the study of the impact of education on income distribution is the

transformed equation of the model, which is

$$X^1 = a_1 D_1 + b_1 S_1 + b_2 S_2 + U^1,$$

where

D_1 = composite demand index

S_1 = supply of university graduates

S_2 = supply of non-university graduates

The coefficients b_1 and b_2 can now be used to derive implications about changes in income inequality if supplies S_1 and S_2 are changed; demand is presumed to stay constant.

The interesting part of Tinbergen's theory is not in its econometric estimation, but rather in its conceptual framework. Supply-demand analysis and utility maximization are sound economic principles to proceed from. But the invocation of weighted manpower coefficients for demand representation imparts a certain rigidity to the model. What kind of substitution possibilities exist amongst different skill attributes for the available job? And if utility is mainly a function of income, and income mainly a function of education, then isn't the Tinbergen model much like a human capital model?

SECTION IV (b) -- THE THUROW-LUCAS JOB COMPETITION MODEL

Another approach to income distribution has been recently advanced by Thurow and Lucas [131]. Rejecting, like Tinbergen, the exclusively supply side view of the market, the authors present a job competition model as opposed to the wage competition model of human capital theory.

The wage competition model is what the authors denote to be the "supply side view" of the market. According to this view, the educational expansion in the U.S. over the past two decades should have had a three pronged effect on the distribution of income: (a) some individuals should have been raised, by educational attainment, to higher income jobs; (b) the decrease in supply should have raised earnings of low income jobs, and (c) increased supply should have depressed wage levels for the high income jobs. The overall effect: a more equal distribution of incomes (earnings).

Empirical data for the U.S., 1950-1970, shows according to Thurow-Lucas, a slight change towards inequality in the distribution of income. This same period was accompanied by an increase in the level, and decrease in the variance, of the educational distribution. This "perverse" result leads them to offer an alternative model of income determination -- the job competition model.

Formally, the model has two sets of factors determining income; a demand factor, which reflects the distribution of job opportunities in the economy and a supply factor (not necessarily independent of demand)

reflecting the attributes for jobs possessed by labor. Suppliers of skills are distributed along a labor queue, and one's relative position in the queue is determined by the level of training costs involved in training one for a specific job -- those with the lowest training costs are the first in line.

The element of training costs is crucial to the job competition model. It is due to the fact that job skills are not initially possessed by the workers that training costs are involved to transfer the requisite skills to them. To the extent that producers pay part of these costs, they are interested in minimizing them. And to facilitate the proper selection, the workers are ranked along a labor queue according to decreasing training costs. But since evidence on specific training costs for specific workers are lacking, the authors invoke the use of background characteristics (age, sex, color, education, etc.) to explain the ranking of a worker along a labor queue.

This labor queue is a reflection of the supply side of the market; the demand side is represented through the distribution of job opportunities. This distribution is affected by three factors - the character of technical progress, the sociology of wage determination and the distribution of training costs.

It is the last mentioned factor to which the authors pay maximum attention. The role of training costs is closely related to the concept of specific training introduced in Section II. If most skills are learnt on the job i.e., if most jobs involve a fair amount of specific training, then training costs do play an important role in the hiring process. What empirical evidence is there to support the

author's contention that specific training is involved in most jobs? They report the results of a survey which found that most skills were learnt on the job i.e., were job specific rather than learned in school. Thus, they conclude that "the labor market is not primarily a market for matching demands and supplies of different job skills, but a market for matching trainable individuals with trainable ladders."

What are the effects of education on the distribution of income in the Thurow-Lucas model? The answer depends, amongst other factors, on the rigidity of the job distribution. Changes in the supply attributes of workers due to expanding education may or may not affect the pattern of demand (job or income opportunities).

For instance, in a rigid job distribution world, an increasing supply of college workers does not necessarily lead to a decline in wages of the jobs held by existing college graduates; particularly if a lot of specific training is involved in those jobs. The average wage and the rate of return to college education might go down with an expansion in supply because college graduates are now "bumping" secondary graduates in the labor queue and taking on a lower wage. The effect on income distribution might be negligible because the job distribution may not be affected the in by/change/supply. Structural factors will also prevent an effect on the distribution of income. "More potential plumbers will not lower the wages for plumbers since the market is structured in such a manner that individuals cannot learn plumbing skills unless there is a job opening available. Such a job will not exist unless it can generate enough marginal product to pay the current wage."

Education can have an impact on income if in some way increasing education means decreasing training costs. Education can have a two sided effect on training costs: (a) it might decrease training costs to the extent that education makes one adapt more easily to one's job, environment, new technology, etc., and (b) it might imply lower training costs because of skills learned in school.

Whether lower training costs are translated into higher earnings would depend on who bears these costs - employer or employee. If the employee bears training costs, observed earnings, or net incomes may go up for those with increased education. The gross earnings distribution, however, may not be affected.

If training costs are affected by education, and if reduction in training costs or its distribution affects the distribution of income, then education can have an effect on the distribution of income. The analysis of the impact of education gets us into general equilibrium analysis; the direction of the effects of some of the parameters involved, however, can be inferred. In particular, for education to have an impact on income, both the amount of training costs involved in the jobs and the elasticities of these costs with respect to education will have to be large. If either assumption about the real world is not satisfied, education may have little impact on the distribution of income.

Education, however, can strongly affect mobility within an income distribution. If incomes are job specific, and if education is an important background characteristic, then equalization of education will allow more individuals to compete for the 'rigid' jobs. This

increased competition may not affect incomes, but will definitely affect mobility.

There is one major advantage in looking at the world through the eyes of Thurow-Lucas. Their model presents a "neat" explanation for intra-group variances in income. These variances cannot be easily explained by the human capital model. Why should equal workers show disparate incomes to the extent they do in the U.S. economy? Why aren't wages for equal workers equalized? If educational investments are equal, why aren't wages equal? The Thurow-Lucas model can easily explain this discrepancy. Workers might be equal in terms of training costs before the relevant skills are imparted to them. After the workers have been placed in different jobs, and trained, they are no longer equal; now, differences in productivity and earnings arise due to the different jobs they hold. Thus "an equal group of laborers (with respect to training costs) might be distributed across a relatively unequal distribution of job opportunities."

SECTION IV (c) · A COMPARISON OF THE THREE MODELS

In this section a few comments will be made on the similarities and differences in the three theories of income distribution. Regarding the wage competition and job competition models, it should be noted that the latter has been offered by Thurow-Lucas as a 'polar-opposite' view of the economy; the authors readily admit that reality lies somewhere on the continuum in between.

The importance of skills learned on a job to the Thurow-Lucas model was brought out in the previous section. This element ^{also} plays an important role in the divergence of the two theories. Specific training in jobs shifts the location of the economy towards the job competition pole. It also makes incomes job specific, rather than individual specific, as is the case with the human capital model.

The role of education in the two models depends on the impact it can have on training costs. And if training costs are significantly affected by education, then a certain confluence of the two theories can be noted.

The Tinbergen and Thurow-Lucas models are alike in the sense that both define a set (rather than just one, education, as is the case with human capital theory) of attributes or skills on the demand and supply side. They differ because Tinbergen invokes factors like utility, and tension between distributions to determine relative wage levels; Thurow-Lucas resort to the structure of the economy for their explanation.

The differences in the three theories can be seen by hypothesizing the effect on income distributions of a more equal pattern of education.

Human capital theory predicts, ceteris paribus, a more equal distribution of earnings; the Thurow-Lucas model may show no effect on the (fixed) distribution of marginal productivities (income); and the Tinbergen model would give results depending on the nature of tensions existing before and after the increased supply of educated manpower. If the distribution of the demanded and supplied qualifications are brought closer together through the process of equalization of education, incomes would become more equal.

Though the human capital and Tinbergen theories predict similar results in this case, the results differ when an alternative situation is examined. For instance, extreme differences in human capital investment may still result in equal incomes according to Tinbergen, but not according to the human capital model. It will be recalled that what is of importance to the Tinbergen theory is the matching of the distributions of the qualifications required with the distribution of qualifications available. It is the tension between the two distributions which gives rise to incomes.

"Equal incomes are possible not merely if all people are equally skilled - which they evidently are not - but already if only the skill distribution required by the organizers of production coincides with the actual skill distribution."

SECTION V - RATES OF RETURN - THEIR MEANING AND USE

In the previous sections, we examined the theoretical relationship between education and income. In this section we will shift gears and examine the nature of the empirical evidence offered to support the contention that education does affect income.

One of the most common methods of estimating returns to education is through rate of return (hereafter referred to as RR) analysis. In recent years, there has been a proliferation of such studies, most of them conducted in the developing countries. (Pscharapoulous [92] has an extensive survey and analysis of these studies.) The assumed importance of RR analysis is probably due to the fact that it has been offered as an alternative to the manpower approach for purposes of planning. (Rates of return are signals which indicate where investment should take place. Efficiency in allocation dictates that the RR be made equal to each other and the social opportunity cost of physical capital.)

Another useful aspect of RR analysis is that it can be considered part of human capital theory. If one makes the assumption that foregone earnings are the only cost of education (in reality they are a major component) then the internal rate of return is theoretically equal to the rate of return estimated through use of the human capital equation (see Equation (1), Section III). The connection with the human capital approach can also be seen through Becker's model: the demand curve for education is no more than the internal rates of return to different levels of education. Thus, rate of return calculations can be used to help buttress the theoretical contentions of the human capitalists.

But what does RR analysis tell us about the impact of education on income inequality? To the extent that costs, enrollments and rates of return are known, one can infer the income distribution of tomorrow. The inference is not so straightforward if patterns of rates of return are affected by changes in supply. And it is to a study of this important issue that we now turn.

Whether or not rates of return to education are affected by changes in supply is dependant upon the nature of technical progress and the assumed technology of production. In particular, what is of interest is the elasticity of substitution (σ) between different kinds of labor. There are three possibilities; $\sigma = \infty$, $\sigma = 0$, or $0 < \sigma < \infty$. Let us examine each of these values of σ for their impact on income inequality.

If the elasticity of substitution between different types of educated labor is infinite, which is the assumption behind rate of return analysis, then changes in relative supplies will have no effect on relative earnings. Absolute levels of income between different types of labor may change, but relative levels will remain constant. A college worker will always be χ times more productive than a secondary worker; his wage will therefore be χ times that of the secondary worker, and remain so, regardless of supply. If σ is indeed equal to ∞ , inferences about the effect of education on income distribution can be deduced through RR analysis.

What about the polar case of $\sigma = 0$? This occurs in the fixed input-output kind of economy (Leontief type). Economic analysis does not have much to offer by way of wage determination in this case, and inferences about income distribution depend on other assumptions.

Since proportions are rigid, an increase in any factor decreases its marginal productivity to zero. In fact, marginal productivity has no meaning in a Leontief world; wages are therefore best determined by considerations of average productivity and notions of distributive justice. (If one defines an objective function, linear programming methods will produce "marginal productivities" in a fixed input-output world.)

What if σ lies between 0 and ∞ as is probably the case? Relative supplies will now definitely affect relative wages; the demand for labor will be downward sloping and expansion of college manpower should lead to a decline in the college wage. The magnitude of the decline will, of course, depend on the elasticity of substitution in production (and the assumed nature of technical progress). If one knew the value of σ , one could use rate of return analysis to estimate effects on income inequality of changes in supply.

If σ is less than ∞ , then changes in relative supplies will usually have an effect on relative wages. However, it is possible for σ to be less than infinity and yet for relative wage levels to remain constant. This occurs when there is strong complementarity between educated labor and capital intensity in production. If, for instance, the nature of technology is such that the demand for higher level manpower keeps pace with increased supply, then the rate of return to higher education would be prevented from falling. Relative wage levels would have been maintained, without the elasticity of substitution being equal to infinity.⁵

Why should one expect complementarity between educated labor and physical capital? A detailed discussion on this subject is contained in Griliches [42] and Welch [113]. Here, we will just relate some observations by Dougherty [37] on the subject. He states that there is reason to believe that "a correlation exists between capital intensity and the demand for more educated types of labor. The greater the capital intensity, it may be argued, the greater is the sophistication of the technology being used and hence the greater the demand for specialists. The reason for this relationship is the fact that those countries with the greatest stocks of physical capital per capita have been the industrial pioneers and have been responsible for the application of new scientific discoveries to industrial processes. Those countries have also had relatively highly educated labor forces, largely as a result of social pressures; and in consequence the new industrial processes have tended to be designed to make use of the skills available. Hence one may expect a supply-induced joint use of capital and skilled labor in advanced countries to imply a complementary demand for them in less developed countries."

SECTION V (b) - EMPIRICAL ESTIMATION OF THE ELASTICITY OF SUBSTITUTION, σ

As we have seen in the preceding pages, knowledge of σ is crucial to our understanding of how rates of return to education are affected by changes in supply. In the elasticity of substitution between different types of labor less than infinity? Recent research indicates that it is, though empirical estimates differ by author and data.

The elasticity of substitution σ is a pure number which measures the rate at which substitution takes place. If L_x and L_y are two inputs in a production process, then σ is formally defined as the proportionate rate of change of the input ratio (L_x/L_y) divided by the proportionate rate of change of the ratio of marginal products:

$$\begin{aligned}\sigma_{xy} &= - \frac{\partial \log (L_x/L_y)}{\partial \log (MP_x/MP_y)} \\ &= - \frac{\partial (L_x/L_y) / (L_x/L_y)}{\partial (MP_x/MP_y) / (MP_x/MP_y)}\end{aligned}$$

where L's indicate relative supplies of the two inputs

MP's indicate marginal productivities, and

X,Y indicate inputs. (for this section, X = college manpower,

Y = secondary school manpower).

If perfect competition is assumed, σ can be estimated in the following form:

$$\log (W_x/W_y) = a + b \log (L_x/L_y) \quad (A)$$

where $\sigma_{xy} = -1/b$

(Note: ratio of wage levels have been substituted for the ratio of marginal productivities; this is only possible under the aegis of perfect competition, when wages do correspond to marginal productivities.)

Pscharapoulos [92], has estimated equation (A) for two sets of data; by developed and less developed countries (LDC's). It is not clear how meaningful is the estimation of σ for the two inputs (college and secondary school manpower) from cross section data across countries. Nevertheless, σ was estimated and found to be near infinity for the developed countries (DC) group. For the LDC's, however, σ was found to be about 2.4. This of course suggests that relative supplies are a better indicator of earnings in developed as opposed to developing countries. (Estimates of σ by Dougherty [37] and Bowles [14] were also found to be significantly less than ∞ , or b of equation (A) to/significantly be different than zero, for the developing countries).

What are the implications of an elasticity of substitution less than infinity for computations of rates of return, educational planning and income patterns? As we noted in the introduction to this section, RR analysis had gained its popularity because of its usefulness as a policy tool (and its presumed superiority to manpower planning). A traditional, and fully justified, criticism of RR analysis as a planning tool has been its assumption of σ equal to infinity i.e., that computed rates of return do not tell us anything about how these rates change with relative supplies.⁶ In allocative terms, RR only tell us where resources should be put, but not their magnitude. (The trial and error method of equalization of rates of return, can be costly and is highly unscientific; moreover at least theoretically, it can lead to an unstable cobweb type of mechanism.)

This failing of rate of return analysis can be overcome if one has knowledge of the elasticity of substitution between different factors of production. Response of rates of return to relative supplies can be calculated with knowledge of σ ; (income distribution effects of educational policies can also be similarly computed). Precisely such an attempt has been made by Dougherty [37]. Using a constant elasticity of substitution production function, Dougherty attempts to determine the effects of relative supplies on rates of return through a feedback mechanism. (Rates of return determine enrollment patterns resulting in new rates of return). Though his analysis was geared towards efficiency in the allocation of resources (i.e., equalization of the rates of return), such studies can also be used to derive implications of income patterns. (As Dougherty himself notes in his appendix this study was conducted under some rigid assumptions: constancy of σ across all types of labor and constancy of σ between all types of labor and capital, amongst others).

This completes our brief foray into the developing literature on the elasticity of substitution between different kinds of labor. Though data problems may prevent a more extended analysis, research in this area is welcome for the light it might shed on the planning of education. Moreover, implications for resulting patterns of income distribution can be derived with a knowledge of σ ; the lower it is, for instance, the faster will relative wage levels contract with an expansion in supply. A more equal distribution of earnings can thus be achieved through appropriate changes in educated manpower, e.g. by deliberate creation of an oversupply of qualified and a shortage of unqualified manpower.

SECTION V (c) - RATE OF RETURN ANALYSIS - QUESTIONS AND ISSUES IN RESEARCH

Rate of return analysis has an important bearing on the "connection" between the education and income distributions. As such, answers to problems involved in the computation and use of rates of return are useful for distributional analysis of income. In this section, we review some of the "problem" areas of rate of return analysis, in the hope that the discussion would throw some light on the relationship between education and income.

(i) Bias in RR estimation - work leisure choice.

The price of leisure is never considered explicitly in rate of return calculations. The work leisure choice is not accounted for by the analysis and wages are presumed not to affect labor supplies ($\partial L / \partial w$ / ^{is} assumed equal to zero). This seriously biases rate of return estimates to educational investment. Similarly, to the extent income is used to estimate rates of return rather than hourly earnings, biased estimates are again obtained since final income is the result of the work-leisure choice.

(ii) Does cross section data reveal time series behavior?

Theoretically, what needs to be known for a "correct" rate of return analysis is benefits from education in the ensuing years. Since time series data cannot be known ex ante, it is derived from existing cross section data. How valid is the exercise?

In a cohort analysis for the U.S., Hollister [58] shows that rates of return computed from cross section data differed significantly from that observed through time series data. No systematic divergence was observed either between levels of education or across the different cohorts studied.

In his study, Hollister speculates that factors like changes in relative supplies of labor, pattern of demand and business cycle effects probably account for the difference between cross section prediction and time series behavior. This suggests that the relationship between education and income is more complex than that predicted by simple rate of return analysis. More complex models are called for. (Incorporation of σ different than infinity is a step in this direction).

(iii) Wages and marginal productivity -- how related?

Even if cross section figures are taken as valid indicators of future income streams, there still is the question of the accuracy of wages as reflectors of marginal productivities. Relative wages and rates of return can only act as reliable indicators for social policy if they reflect differences in productivity. If political, institutional and other such non-market factors determine wages, then attempting to affect relative wages through educational policy might be a mistake.

Non-market forces probably play a greater role in determining wages in developing than in developed countries. This might be partly due to the fact that the public sector in developing countries is a relatively large sector and one which is more susceptible to political and historical considerations. Salary scales and educational qualifications are set rigidly and move in a fixed pattern with the rest of the economy, not much affected by changes in supply. Thurow and Lucas [109], writing for the U.S. labor market talk about the sociology of wage determination. "If utility functions are interdependent and conditioned by experience and history, changes in relative wages will be very difficult to bring about since historical wage differentials have the sanction of time."

To the extent the economy is of a mixed type in developing countries, competition with the private sector should equalize wages across sectors. However, this would depend on the relative sizes of the two sectors and on who is the pace setter; in some developing countries, the public sector is the dominant one and sets the pattern of wages. (See Knight [69] for evidence on this matter with respect to Ghana).

One should be cautious of interpreting wages as marginal productivities for another closely related reason. This has to do with the prevalence of the "sheepskin effect" i.e. to what extent is educational background used as a screening device. There can be two interpretations of the screening process. If educational qualifications are correlated with productivity, then the screening role of education is a useful one - it decreases information costs.

But if educational investment is not related to increased productivity, but merely indulged in by individuals for defensive purposes, (see Thurow-Lucas [109]) then increased education may have no net effects in terms of social output. People might overqualify themselves in order to compete successfully with those having lesser qualifications; even though these extra qualifications are not needed for the job. Increased education, therefore, may not mean increased productivity. Bhagwati [10] has an interesting idea to document this process of overqualification. His recommendation is to systematically compare, through means of a survey, the ex ante (advertised) educational requirements with ex post "revealed" educational requirements. This problem of overqualification is particularly acute in developing countries and the degree to which it exists implies a corresponding waste of a country's scarce resources.

As regards income distribution implications are concerned, the sheepskin thesis would mean that equalizing education would at least result in increased mobility. Whether more equal education would have an impact on the income distribution would depend on the nature of jobs and how their wages are determined.

(iv) Educational stock, enrollment patterns and rates of return.

What do patterns of rates of return reflect? There are two views on the subject. Cross section distributions of income (from whence rates of return are derived) can either be viewed as a reflection of past investment decisions or as a harbinger of things to come. Hansen [44]. Each assumption implies a different relationship between enrollment quantities and relative rates of return. If RR reflect past investment decisions, then relative quantities of education should be inversely related to relative rates of return. If rates of return act as a signalling device, then relative enrollments and returns should be positively related. Empirical research generally indicates that the latter interpretation is likely, though the results are by no means conclusive.

An interesting area of research is the analysis of enrollment patterns. How fast is the response of enrollments to expected income? This would be a good test of the philosophy (sic) behind the human capital model -- if education is indeed viewed as an investment, then students should choose and change into areas that show the highest rates of return.

Lack of data has prevented a systematic examination of this hypothesis. Time series data by occupation is needed; a kind of data not easily available. However, a time series combination of census data might throw some light on the matter.

This completes our short survey of the problem areas of rate of return analysis. More questions have been raised than have been answered; but that is the state of the art (or science). As Hansen [44] observed in his review article "As yet we know little about the relationship, if any, between the rates of return to the various levels of schooling and other characteristics of the economy and society -- its level and rate of development, the level and distribution of educational attainment, the current flow of graduates from the educational system, and the like."

So far we have been concerned with the theoretical underpinnings of the education-income quandary; in the next two sections, we will change emphasis, and evaluate educational policies for the possible impact they might have had, or will have on income distribution. The areas being looked into are: (a) Income Distribution Effects of Educational Finance and (b) Intergenerational Transfer and Class Mobility.

SECTION VI - INCOME DISTRIBUTION EFFECTS OF EDUCATIONAL FINANCE

Apart from the eventual impact that a pattern of education might have on income distribution, immediate distributive effects can also be observed in the education sector.

These effects arise because of the method of educational finance. Private expenditures on education often form only a small portion of actual costs; the subsidy is made up by private contributions and public expenditure; government intervention in this sector is economically justified because education is almost a classic case of "external benefits." Concrete specification and quantification of these benefits might be difficult; nevertheless, they are there. Imperfection in the capital market for educational finance also justifies involvement on the part of the government, but external benefits are more the justification given for public expenditure.

These same external benefits which justify the case for subsidies also leave ambiguous the extent of these subsidies. (How does one measure benefits like flexibility of the labor force, informed electorate, restructuring of attitudes towards development, greater enjoyment of life, ad infinitum). But given that the public sector has a share in the expenditures, and in most countries it is a major portion, the question of incidence arises: who pays for the costs and who derives the benefits? The answer to this question is important for several reasons: it can help us to know if there is equal opportunity for education, whether there is mobility between classes, and whether, through the method of finance, redistribution of income is taking place.

Such an analysis of the incidence of benefits and costs of education was done first by Hansen & Weisbrod [46, 47]. Their study dealt with the system of higher (undergraduate) education in California. Higher education because any analysis of the benefits and costs of education would have to take into account the structure of the "terminal" part of public education i.e., college. California was the state chosen; it made an interesting case study because at the time the research was conducted it was widely believed that this state had the most equitable educational system in the country.

Before we proceed with a discussion of their analysis, the nature of the two different redistributive effects that educational finance can have should be made clear. Hansen and Weisbrod (H-W) are concerned explicitly with only the static redistributive effects; i.e., with net transfers taking place amongst income groups at the present point in time. This kind of study is akin to the study of the redistributive impact of any other form of public expenditure. But the education sector is unlike any other sector. If education is an investment, then educational opportunities today will affect income distribution tomorrow. This dynamic aspect of education makes the study of the modus operandi of educational finance all the more important.

This dynamic, or intergenerational aspect, of income transfers is not discussed explicitly by H-W; their study, however, can help us to draw some conclusions on the matter. The issue will be discussed in more detail in the next section.

Basically, the approach taken by Hansen-Weisbrod in their study is as follows: Attendance in college and type of college (junior college, state college, university) by income classes is determined; from knowledge of total costs and direct student payments, gross subsidies are determined. A selected

set of state and local taxes are used to estimate incidence by income level. These taxes are then allocated to the different branches of the college system to get an estimate of the average taxes paid, by type of college. Subtraction of these payments from gross subsidies gives an estimate of net average subsidy by type of college attended. Noting that children from upper families attend the better and more heavily subsidized sectors of the college system, the authors conclude that the system is regressive. In their words "the effect of these subsidies is to promote greater rather than less inequality among people of various social and economic backgrounds, by making available substantial subsidies that lower income families are either not eligible for or cannot make use of because of other conditions and constraints associated with their income position." [47].

Two points in the H-W analysis have given rise to a healthy, and as yet, unresolved debate. One issue is the question of incidence -- since education is just one sector supported by general tax collection, how does one know as to which taxes, and in what percentages, go to support a particular program. Pechman [87] recommends the proportionality approach i.e., $\chi\%$ of a taxpayer's dollar goes to education if $\chi\%$ of the government's budget is spent on education. Hansen and Weisbrod believe this to be an arbitrary assumption. It is their contention that particular expenditures and the taxes used to finance them should be viewed in a marginal, rather than average, fashion. The relevant question is not gross payments of taxes but which taxes will be increased (reduced) and in what proportion, if expenditure in a given sector was to be increased (reduced). Since it is highly unlikely that such a procedure will result in an equiproportional effect on all taxes paid at each income level, the proportionality assumption is untenable.

Empirically, it is difficult to make the marginal analysis that H-W suggest. Consequently, they take a second best approach -- comparison is made between benefits and total taxes paid. It is not clear how this approach is closer to a marginalist one than Pechman's.

In a recent article, Hight and Pollock [56] propose a modified version of the Pechman method of determining the distributive impact of public expenditure on education. They propose a comparison of the two distributions: "the percentage distribution of students by family incomes and the percentage distribution of state local tax payments by income class." Conclusions about the redistributive impact of education are derived from the direction of the divergences in the two distributions. (See also discussion of Jallade [62], below).

The second issue raised by the Hansen-Weishrod analysis concerns the question of the classification of benefits. As we have noted, H-W classify benefits received by type of college attended. (They compare this with enrollment data to conclude that the rich get more subsidies). In contrast, Pechman classifies benefits by income classes. Taxes are also classified in a similar manner. Comparison shows that though the rich receive more benefits, they also pay more taxes. In fact, the H-W conclusion is reversed by this method; the educational system of California turns out to be mildly progressive.

Which method is correct? The answer depends on what one is looking for. If policy implications are to be studied, then the H-W approach is probably more useful. This because H-W compute the subsidies received by an individual, not by income levels alone, but also by type of college (junior, state or university) attended. By observing the attendance patterns, H-W

are able to pinpoint the likely beneficiaries (losers) of an expansion/contraction of educational subsidies by type of college attended. Since educational finance policy is probably made with reference to whether the institution is a junior college, state college or university, the H-W approach might be a more direct method of inferring the direction of the distributive impact of these policies.

All the studies cited so far have been U.S. studies; the choice was forced upon us because such studies have not yet been conducted elsewhere. (Richard W. Judy [66] has a similar study on Canada). There is one notable exception, and that is a case study on Colombia which has just been completed by Jean-Pierre Jallade [62].

His report is in two parts; the first part is an excellent survey of the basic issues involved in the financing of education, and the second part consists of an exhaustive case study on Colombia.

As in the other studies, the discussion is centered around the two basic questions: Who pays for the education? Who receives the net benefits? In order to compare the distribution of educational benefits with the distribution of total taxes paid by each income class, Jallade presents his results in a ratio form: subsidies received as a proportion of total tax payments. The distributional impact is noted by comparing these ratios with the average for the country as a whole or across income groups or geographical units. (Note that this method, unlike the proportionality approach, does not allow the computation of exact transfers resulting from one population group to another through the education sector).

Jallade supplements his analysis with an important consideration -- the presence of private schools. To the extent that the subsidies to private

schools are considerably less, and that richer people generally tend to send their children to these schools while paying taxes for support of public schools, there is an increase in the progressivity of income redistribution in the education sector. And the impact is by no means marginal; in Colombia, private post secondary students account for about 50% of the students. The general conclusion: the system of educational finance is progressive in Colombia.

(The effect of private schooling on static redistribution of income is by no means certain. Colombia has a high proportion of students in private colleges. In India, the best universities are public and the level of subsidies is high. Upper class parents in India probably recoup the subsidies they give to the poorer children in public elementary and secondary schooling by enrollments of their children in public universities. These tend to be exclusive, merit universities and the pattern of enrollment is heavily skewed in favor of the upper classes).

But what do these case studies tell us? Of what importance is the fact that in one sector of government there is progressivity or regressivity of income redistribution? If interest is in the issue of income redistribution through government policies, then shouldn't attention be concentrated on the net effect of all policies, rather than just one sector?

There are two sets of arguments which can be used to counter this criticism. One rationale for these studies centers around the fact that in developing countries at least, the budget for education is of a sizeable nature (often between 15-20% of the total budget). A study of its redistributive effects is therefore, ipso facto, pertinent. A more telling defense of such studies is the fact that the education sector is a unique sector -- it

has besides a consumption, a substantial investment component. If education has an impact on income, then access to it determines one's future income. If the education sector is found to be regressive, then it might be reasonable to conclude that not only are the poor subsidizing the rich of today, but also helping them to stay rich tomorrow. A study of the static redistributive effects is therefore useful for considerations of equal opportunity, mobility, and equity.

These case studies, useful and informative as they are, have one important shortcoming: they fail to take into account, directly, the long term effects of education on the distribution of income. The long term issue is inherently complicated by the fact that the people who receive the benefits are not the same as those who pay the taxes. Even if one ignores this important aspect, there is still something questionable about the methodology of these case studies. In particular, the calculation of benefits is "misleading." The benefits are computed as present expenditures on schooling minus payments. But how, through education, are benefits in terms of permanent incomes being allocated? Is a \$100 subsidy at a junior college the same as a \$100 subsidy at a university? If the rate of return to a university education is higher, (as opposed to a state college) then the long run benefits might vary systematically with the level and type of education received.

The issue of long term benefits, therefore, is of crucial importance to any discussion of the impact of educational policy on the distribution of income. Static analysis are useful, particularly if they show the redistributive element to be regressive; then, one may safely infer that the long term effects
/are likely to be worse (in terms of progressivity). But one should be wary of drawing immediate conclusions from case studies showing a progressive element in the educational sector; the progressivity might very well be still-born.

SECTION VII -- CLASS MOBILITY AND INTERGENERATIONAL TRANSFER OF WEALTH

The analysis of the long run impact of education, alluded to in the previous section, has been one of the relatively ignored areas of education economics. Though patterns of income distribution have been studied, little research has been conducted on the question of movement within distributions and across generations.

Effects of education can be perceived or studied in two different ways: either one can talk about the changes in the variance of the income distribution, or about mobility within a constant or even changing variance. Each "result" has different implications for ethics and policy. Even though the variance in income distribution were decreasing over time, one may be dissatisfied with the fact that there was no movement within the distribution. (The bottom 10% remain locked in.) Alternatively, one may be quite satisfied with a large variance in income distribution, if it was accompanied with extreme mobility (e.g. even though the rich have 'too much' income, the determination of who becomes rich is random). How does education, then, affect the variance of income distribution and mobility within it?

Economic theory has concentrated mostly on the variance part of the analysis, and as shown in Sections III and IV, gives ambiguous answers to the question of educational impact. The topic of mobility is inherently more complex, particularly from the empirical point of view. In this section, we will try and discuss some of the issues raised in the literature.

It has been conventionally assumed that education has a positive impact on mobility, i.e., equalizing education would increase mobility between income levels. In the Thurow-Lucas world, even though the set of marginal productivities produced by the market may have a large variance, access to better jobs may be equal by the expansion of education. But to the extent that other attributes also affect one's position in the labor queue, (and these are intimately related to family background) there may indeed be little mobility observed with the equalization of education.

Indeed, this is the point made by Bowles [20] in a study of the U.S. He contends that the influence of family background upon economic and social status is both quantitatively significant and relatively stable across periods of time. Even though educational opportunity plays a significant role in the determination of one's status, 'more than half of the intergenerational status correlation, however, is accounted for by the direct effects of family socio-economic background operating independently of educational attainments and IQ.'

Arlene Leibowitz [76], in her discussion of Bowles' paper, contends that the immobility observed might be a simple reflection of differences in human capital. Class background characteristics, for instance, might very well be proxies for quality of education at any given level of schooling. Moreover, family background variables might reflect the amount of investment at home, particularly through the educated mother. (The importance of the mother's influence in human capital investment has been lamentably ignored in research.) A similar point was made by Becker [7] on a different article by Bowles [19]. As evidence of the possibility of differential preschool and home investment, Bowles notes that the labor force participation rate of educated women is higher than

other women, except when young children are present. When they are present, educated women presumably withdraw from the labor force to invest in their children, and the increased productivity (incomes, status) of these children is probably the result of this investment. What the human capitalists have done is to provide a rationale for class immobility, and not an answer to the problem of structural immobility.

Bennet Harrison [52], in his analysis of the ghetto, (U.S. kind) reaches similar conclusions as Bowles regarding immobility. He basically questions the assumption that education increases a ghetto worker's productivity: it doesn't because of limited access to the more productive jobs. Class and race discrimination limit this access. The poor and black are recirculated in the periphery of the economy with little chance of escape. Consequently, little mobility.

Jencks, et.al. [64] in their recent study for the U.S., reach a slightly different conclusion. Though they do not deny the statistical significance of educational attainment and family background in determining one's relative income, they nevertheless maintain that the effect is marginal. They conclude, a la Thurow-Lucas that inequality is given, almost like a manna from heaven. Moreover, access to occupations (incomes) is dictated to a considerable extent by luck and other unmeasurable factors and that there is very little one class can do to perpetuate its position. "Neither family background, cognitive skills, educational attainment nor occupational status explains much of the variance in mens incomes."

Within group variances are found to be greater than between group variances, and men from the same socio-economic background are found to have as much variance as among men in general. (This observation obscures the fact that the range of incomes might be systematically related to socio-economic background). Therefore, "eliminating differences in social class backgrounds will not take us very far toward eliminating income inequality."

The general thrust of Jencks' analysis is that there may be considerable mobility in American society but that income inequality cannot be much affected by changes in educational attainment or by neutralizing the effects of family background. The statistical basis of Jencks' analysis has been criticized, most notably by Hartman [54] who concludes that there is nothing in Jenck's analysis to shake one's belief in the efficacy of better educational opportunity in affecting one's income chances, nor does it negate the importance of family background on one's earnings.

The controversy on statistical methods notwithstanding, Jencks' book has been useful in instigating a reassessment of the approach to income inequality. Jencks eschews the conventional approach of affecting income distribution through the market place via education; like Thurow-Lucas, he believes that the set of income slots produced by the market is rigid, and that, therefore, "the first step toward redistributing income is not devising ingenious machinery (e.g., equal education) for taking money from the rich and giving it to the poor, but convincing large numbers of people that this is a desirable objective".

And then -- equalize incomes through the political process rather than institutions of marginal impact like the schools.

The problem of immobility is much more acute in the economics of the developing countries. Class status in these countries is perpetuated with the help of the educational system. The upper class attends the better schools, sends a disproportionate amount to the universities, and achieves higher lifetime incomes. Even "free" schooling does not lead to equal educational opportunity. A survey of Indian villages found that attendance in free primary schools varied systematically with family income. (The system is not really free, since for poor students foregone earnings can be a major component of a family's income.) When one adds factors like motivation, encouragement, and quality of schooling, to the causes of non-equal educational opportunity, the immobility appears to be that much more transfixed.

Traditionally, it has been assumed that one of the surest ways of affecting mobility is through the education process. Even if there was no impact on inequality, at least education would make access to incomes more random and therefore more equitable. This reasoning was and is behind many of the educational programs of the developing countries; one of the more important external benefits of education is the presumed increase in mobility.

The notion that mobility can be achieved through expansion of the education process has considerable intuitive appeal. It appears to be self evident that it is so, and one might even suspect it of bordering on tautology. But Carnoy [25] cautions us from deriving rapid conclusions.

In his article, Carnoy speculates that the traditional process of expansion of education is biased in favor of immobility. The education system is usually expanded in a primary, secondary, higher progression. Consequently, the labor market is saturated first by primary school graduates, then secondary school and finally university graduates. Private and social rates of return fall in the same progression, and since the lower classes are usually the last to reach these respective levels, they are locked in their relative position. The implications about average and marginal changes in this analysis should be noted. Any given poor student, by himself, may be able to vault into an upper income slot through the process of education. The poor as a class, however, may remain poor, even with more education.

What Carnoy's analysis shows is that the expansion of the education system may not have the desired effect on mobility - at least until the very long run. And even then it is not intuitively obvious that mobility will be affected. Classes in power and with wealth have a tendency to perpetuate their status. Even though mass education might become a reality, factors like quality of schooling, etc. can play a differentiating and immobilizing role. The investment at home argument, considered earlier, also supports immobility. Private wealth, better pre-natal care, nutritional effect, family background considerations and at home investment are some of the factors which seem to structurally bias the lottery of life in favor of the upper classes. What is to be done?

question of class influence on

Before we conclude this section, the/educational expenditures should be noted. Both Bowles [13] and Bhagwati [10] have interesting comments to make on the subject. In his paper, Bowles maintains that the benefits of higher education go to the elites and the benefits of primary education to the masses. If the class structure in developing countries has an influence on state expenditures, and if classes are interested in maximizing class wealth rather than national wealth, then one might expect an underinvestment in primary education and over investment in higher education in the capitalist countries of the less developed world. If rate of return studies are any indication, Bowles' contention that there is underinvestment in primary education does seem to be true.

Bhagwati also contends that the pattern of government subsidization of education reflects class structure; moreover, he adds, the classes that benefit more from any education in general tend to be from the higher income groups. As to why the education sector is such an excellent vehicle for the handing out of these subsidies to the upper classes, Bhagwati offers this convincing hypothesis: "The benefits can be handed out to elite groups by the State without obvious disaffection if they are handled via the educational system which, in principle, at least, is open to all classes and castes and therefore conceals effectively its inegalitarian impact."

SECTION VIII - A DISCUSSION - IN LIEU OF A CONCLUSION

What is the nature of the connection between educational and income distributions? For several reasons (data problems not being the least important) there has not been very much written on the subject.⁷ To be sure, indirect references to and implications about income distribution are usually made, but they are usually done in a casual, footnote type manner. Now that interest in income distribution is increasing, perhaps we shall see some more literature on the subject.

Economic theory, as we have seen in the previous sections, has no definite answers to give on the question. Empirical evidence is recent, fragmentary and inconclusive. Regarding the U.S., it appears that the distribution of income hasn't changed much in the last thirty years, even though the educational distribution has changed considerably. From this we should not necessarily conclude that the distribution of education does not have much effect on income inequality; it should be remembered that basic changes in the structure of American schooling took place before the war (World War II type). Also cross section, as opposed to time series data, does seem to indicate that education has some impact on income inequality. (cf. Section III and Chiswick [33]). It could be that initially mass education does have a significant impact on the pattern of earnings, but that after a certain level of compulsory schooling is reached, diminishing returns in terms of effect on income inequality set in. In other words, to note the effect of education one should compare inequality in 1950 with that of, say, 1920, rather than 1940.

In a recent study, Carnoy [26] compares changes in income and education inequality for three countries -- U.S., Brazil, and Mexico -- for the general period 1940-1970. In the U.S., as we have noted before, there has not been much change in income inequality. Brazil and Mexico have both gone through a rapid and massive change in their education distributions. Their income distributions have, if anything, become less equal.

Hollister [58] also found little evidence to suggest any concrete relationship between education and income inequality. Using a Gini coefficient measure of inequality, Hollister found considerable changes in the education, but little change in the income index for ten Western countries.

Given this evidence, should we conclude that there is no recognizable relationship between the two distributions? Not necessarily, though we should be cognizant of the fact that the equalizing aspects of education may be nullified by the process of capitalistic development. The positive effect of a more equal pattern of education might be offset by the negative rate of return effect on inequality. The pattern of demand, and the complementarity of skilled labor with capital, may prevent the rates of return to higher education from declining and thus having the expected equalizing effect on inequality. On the other hand, it should be noted that even if education was having an equalizing effect, the available data may not show it. Education, it should be remembered, is only ^{one} factor, albeit an important one, in the determination of a persons income.

In light of the findings reported in this paper, what suggestions can be made for educational policy? As usual, policy should be guided by considerations of efficiency and equity. Enough has been written by economists about efficiency; in the concluding sections of this paper, let us devote a few moments to equity.

In developing countries, access to education is a crucial variable in the determination of lifetime earnings. Private rates of return to education are abnormally high in most developing countries, and educational qualifications are almost a prerequisite to economic success, social status and political power. Consequently, the allocation of scarce seats in the educational arena has far reaching implications.

A cursory glance at the educational expenditure of most developing countries indicates that the pattern is very skewed. As one goes up the educational scale, expenditure per student rises rapidly. Though economic considerations also play a part, the education sector has become a political public good; finance is mostly from government revenues, with students paying only a minor portion of the costs. If one adds to this the fact that educational investment is indulged in more (almost exclusively) by the upper classes, then one can perceive the beginnings of a vicious cycle horror story.

To prevent perpetuation from taking hold, and to break the inevitability of the cycle, a conscious attempt has to be made to make the method of finance more equitable. Subsidies to education may indeed be necessary due to efficiency considerations, (though the existence of external benefits beyond primary education is questionable) but a re-allocation of these subsidies between student might be desirable from an equity standpoint. ⁸

It is ironic that the people receiving the most subsidies are probably the ones in least need of them; and surprising that it has not yet been realized by policy makers that private monetary gains may themselves be attractive enough to induce many ^{students} / to pay a greater amount of their education. On second thought, perhaps the policies of huge subsidies to higher education is not surprising -- we saw in the previous section how class interests might dictate such a policy.

If mobility and equal educational opportunity is a policy goal, then notions of access need to be revised. It may not be sufficient to offer low tuition or even free schooling; foregone earnings are an important component of costs, particularly and most importantly for low income students. A flexible pricing policy may be necessary, and unequal people may need to be treated unequally.

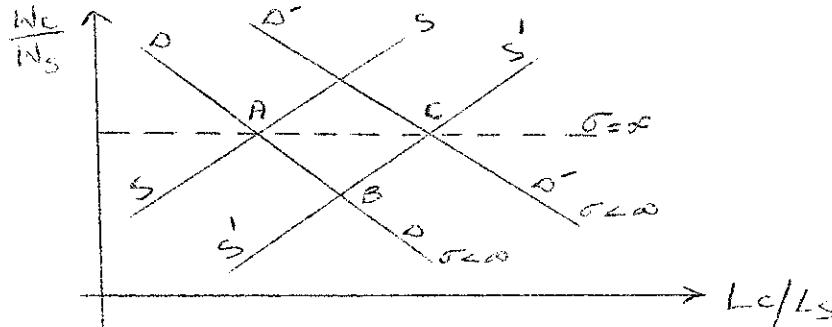
Is there an education-income connection? Can educational policy be used to affect the pattern of income distribution? These are difficult questions, to which an economist can only answer: it depends. But there is something even more disturbing about the questions than the ambiguous answers they give rise to -- it may be that the questions themselves have been phrased improperly. Perhaps we should not be looking for an education-income connection; rather, what might be of relevance is the education-equal opportunity locus.

It is not just the existence of extreme income inequality in the developing countries which is bothersome; what is perhaps even more disturbing and exasperating is the likelihood of its perpetuation. If education can help break the vicious cycle and at least make the prizes

of life more random, it might make inequality that much more bearable. In other words, if education can help provide for equal opportunity (in the broadest sense) of "success" it may have fulfilled its promise. But if concern is with changing income inequality, per se, then..... maybe Jencks is right; perhaps we should concentrate on equalizing results.

FOOTNOTES

1. The path breaking article in the field of human capital was that of Mincer [30]; the field has subsequently been developed extensively by Becker, Chiswick, Mincer, Schultz, et.al. following
2. The/exposition owes much to Chiswick's [33] explanation from whence this author derived his knowledge of the extended human capital model.
3. According to a theorem by Leo Goodman "On the Exact Variance of Products," Journal of The American Statistical Association, Dec. 1960.
4. This observation should be contrasted, rather than confused, with the systematic relationship that might exist between the supply and demand curves for an individual person, e.g. a rich person probably has a higher demand curve and lower supply curve than the average.
5. The preceding analysis is conveniently summarized by the following diagram: (cf. Pscharapoulos [92]).



- W_c = Wage of college workers
- L_c = Supply of college workers
- W_s = Wage of secondary workers
- L_s = Supply of secondary workers

DD is the demand curve for labor. It is shown to be downward sloping because σ is assumed to be less than infinity. If it is stable, i.e., no complementarity between educated labor and capital, then an increase in supply of college workers ($S' S'$) will lead to a decline in relative wages from A to B. In the case of elasticity of substitution being equal to infinity, no decline in relative wages will be observed as movement takes place from A to C. In the case of complementarity, the demand curve itself shifts to $D' D'$, thus showing no decline in relative wages even though the elasticity of substitution is assumed to be less than infinity.

6. This failing of rate of return analysis is shared by the human capital model of Becker, et.al.; their demand curve for education and subsequent analysis is defined only for a fixed amount of investment by the others; how the demand curve changes with relative supplies is not spelled out.
7. Data problems make the analysis more difficult. Since little time series data is available for developing countries, there is not much information on the source of income differentials -- do they exist because of historical circumstances or educational qualifications and what narrowing effect, if any, has the spread of education had?
8. The question of equity and efficiency in the finance of education has lately received a lot of attention in the U.S. There is no reason why some of this same analysis cannot be applied to the developing countries, where the problems are, if anything, more acute. Jallade [61] has a rather good summary of some of the basic issues involved in the finance of education in the developing countries.

APPENDIX I (a)- DERIVATION OF THE HUMAN CAPITAL MODEL

Formally, the human capital model (Equations 1 of text) is developed as follows:

Let Y_N reflect earnings after N years of investment in human capital

Y_0 earnings of an individual with no human capital investment

K_i fraction of Y_0 invested during the i^{th} year of training

r_i rate of return to the i^{th} year of investment

Then, earnings are as follows:

$$Y_0 = Y_0$$

$$Y_1 = Y_0 + r_1 (K_1 Y_0) = Y_0 (1 + r_1 K_1)$$

$$Y_2 = Y_0 (1 + r_1 K_1) (1 + r_2 K_2)$$

$$\text{and } Y_N = Y_0 (1 + r_1 K_1) (1 + r_2 K_2) \dots \dots \dots (1 + r_N K_N).$$

[1] or $Y_N = Y_0 \prod_{j=1}^N (1 + r_j^*)$ where $r_j^* = K_j r_j$ i.e., the adjusted rate of return.

Equation 1 is the basic human capital equation. Differences in ability, luck, access to capital and other determinants of earnings are incorporated in the residual U^* .

$$Y_i = Y_0 \prod_{j=1}^N (1 + r_{ij}^*) U_i^*$$

where subscript i refers to individuals and j to number of years of schooling.

Taking logs of both sides, and noting that $\ln (1 + r_{ij}^*) \approx r_{ij}^*$ when r_{ij}^* is small, we have

$$\ln Y_i = \ln Y_0 + \sum (r_{ij}^*) + U_i \quad (2)$$

If deviations in r_{ij}^* amongst individuals is incorporated in the residual, then

$$\ln Y_i = \ln Y_0 + \bar{r} N + U_i \quad (3)$$

$$\left[\frac{\sum r_{ij}}{N} = \frac{\sum r_j}{N} = \bar{r} \quad \sum r_j = \bar{r} N \right]$$

where \bar{r} is the average rate of return, and N the number of years of schooling.

Equation 3 is the basic form of the human capital model referred to in the text.

APPENDIX I (b) - SPECIFICATION OF THE EARNINGS MODEL - A SUMMARY

The basic form of the human capital model (equations (1) and (2) of text) explains income on the basis of education and training and incorporates other determinants of earnings in the residual. Estimation of this basic model leads to biased estimates if the included variables are correlated with the omitted variables. Researchers have extended the basic model by demystifying the residual ^{i.e.,} U/ they have attempted to introduce variables into the equation which were previously lumped in the residual. This appendix is a summary of this extended earnings model.

In a general fashion, the earnings model is:

$$\hat{Y}^* = b_0 + b_1 S_1 + b_2 Q + b_3 S_2 + b_4 \omega\omega + b_5 Ab + b_6 B + \dots U,$$

where

b_0 = average income without human capital investment

S_1 = formal schooling

Q = quality of schooling

S_2 = on the job training

$\omega\omega$ = employment variable; weeks worked

Ab = natural ability

B = family background (this includes important variables like color, occupational status of father, mother's education, etc.)

Specification of variables

- Y^* - This is the dependent variable and ideally should be represented by hourly earnings. For the human capital model, Y^* is supposed to represent lifetime income. Cross section data is usually used to approximate Y^* . If life pattern of earnings differ from the pattern predicted by cross section earnings, there is an error. The human capital model also requires that Y^* be introduced in log form.
- b_0 constant of the regression; assumed to represent the average income of a person with no schooling; interpretation dependent on what other variables are specified, and how.
- S_1 schooling variable; represented by number of years of schooling. Assumption involved in specification that all increments to schooling have similar impact on earnings.
- Q quality of schooling; inserted because it is recognized that it is not just the amount of schooling that matters but also its quality. Proxies for this variable are expenditure/student and an index that ranks colleges, etc.

This variable has not been sufficiently explored in the developing countries literature. One possible way to represent it for these countries is through a dummy variable which would represent whether one attended a private, or public secondary school. Also, to the extent that education is used as a screening device to allocate jobs, quality of schooling might be an important input in this process.

S₂ On-the-job training (OJT) - As noted in the text, a basic variable of the human capital model. Question of interaction of this variable with S₁ (schooling variable) arises i.e. does education make one better qualified to take advantage of OJT; when can OJT act as an alternative to formal schooling and when is education a prerequisite for on-the-job training.

ww weeks worked - Most recent addition to the human capital model. For explanation, see text.

Ab ability. An important variable in explaining earnings. But how does one measure it? Standard procedure has been to use IQ measurements or qualification test scores [AFQT, GRE, etc.] as a proxy for ability. The tests themselves are questionable. Moreover, variable might be highly correlated with quality of schooling and the family background variables.

B background (includes family status, color, sex). Recently, economists have been stressing the use of mother's education as an important variable affecting earnings (through the at home investment in the child). Also, can represent discrimination due to sex or color. Evidence of a significant coefficient on both has been established in various studies.

This completes our discussion of the standard human capital model. Most of the estimation of this model has taken place in the U.S.; the model traditionally explains on an average about 30-40% of the variance in income. Because of data problems, very few (See Shoup [105], Hoerr [57]) studies have been conducted for the developing countries.

All the studies are of a similar genre, they all reached familiar conclusions of a positive and significant impact of education on income, and they all conclude with the standard caveats of multicollinearity and heteroscedasticity in the regression.

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[Note: Some important literature on rate of return studies is not referenced here because Pscharapoulos (92) has a comprehensive bibliography on the subject.]

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