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FACULTY WORKING
PAPER NO. 929

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February 1983

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Abstract

To what extent can the distribution of income in a society be explained by its distribution of education?

This article focuses on differences in earnings, which are substantial, although differences in total income are of course also due to significant differences in property income among households. Differences in the fraction of earnings attributable to differences in schooling, after controlling for ability, and as measured by the alpha coefficient, are found to range between .80 and .90 in most recent research, for example.

Since human capital formation in school and on-the-job is a major determinant of differences in earnings (other explanations are considered), the underlying causes of differences in schooling become important. Here differences in expected monetary returns are found to be an important determinant of the amount of education demanded, and also to be more important than expected nonmonetary returns. Factors on the supply-of-resources side, however, such as the parents' income and wealth, and the availability of subsidies for tuition and student loans, are seen to be the most important determinants of the amount of schooling obtained. Parental wealth and public support of education, therefore, through their influence on the amount of schooling received, become important determinants of income differences later.

Two fundamental propositions appear to hold true across countries and across time: first, personal income is very unequally distributed; second, income and education are positively correlated. Over the past several decades economists and other social scientists have begun to link these propositions to ask, "To what degree can the distribution of income in a society be explained by its distribution of education?" Most frequently this question has been posed for developed nations, and for the United States and the United Kingdom in particular where cross section and time series personal income data are most readily available. While initial work focused on the effects of differences in schooling levels upon the distribution of earnings, more recent work has attempted to explain the basic causes of these differences in schooling.

This article will consider first, differences in earnings and property wealth as sources of inequality in the distribution of income; second, the relation of education to differences in earnings as developed by human capital theory and empirical research using earnings functions, screening, and life-cycle models; and third, causes of the differences in preschool training and formal schooling which lead to differences in earnings. It demonstrates that differences in the amount of education individuals receive is a major source of personal earnings differences. It will conclude with a consideration of public

policies for the expansion of educational opportunity to reduce inequality and promote economic development.

1. Income Distribution

Personal income consists of labor income, or earnings, plus interest, rent and profit income derived from the ownership of nonhuman wealth. Inequality in the income distribution is due in larger measure to inequality in the distribution of property income than it is to inequality in earnings. This is because wealth, and the income from property are distributed more unequally than are human capital and earnings (Atkinson 1975 Ch. 4-9). As Schultz (198i p. 76) points out, the earnings from the human capital created by education and better health tend to loom increasingly important relative to the income from land and property as economic development occurs. This contributes to greater equality in the distribution of income in the very long run. Education and human capital formation contribute even further to greater equality in the income distribution when elementary and secondary education are deliberately extended to a larger percentage of the population as economic development occurs.

However, even in developed nations a great deal of inequality in personal earnings remains. This article is confined to the sources of these personal earnings differences. Inequality in wealth is discussed only in so far as it affects differences in educational attainment and labor earnings.

Five propositions characterize the distribution of earnings truncated to remove the extreme righthand tail which may represent economic rents to unique talents:

(1) both earnings and educational attainment are unequally distributed across the population;

(2) individual differences in earnings vary positively with differences in education;

(3) the variance of earnings exceeds the variance of either innate ability or schooling attainment; or in other words, earnings differences are not explained by ability and schooling alone;

(4) earnings are positively skewed, and distributed approximately log normally;

(5) the variance of earnings within a given age cohort increases over time.

Traditionally at least three positive theories of the distribution of earnings have competed for attention: the stochastic theory, the ability theory, and human capital theory (Sahota 1978). According to the stochastic theory, an individual's position in the earnings distribution is largely a matter of chance or luck: everyone may begin equal, but chance events create eventual inequality in earnings. According to the

ability theory, earnings inequality is preordained by genetically or culturally determined differences in underlying potential or ability. Common to both of these theories is the notion that earnings are beyond individual control. In contrast, human capital theory asserts that earnings are determined by actions taken and choices made by individuals and their families. Parents help their children to choose an amount of education, subject to some environmental constraints such as the child's ability and family financial resources. This education, in turn, influences the individual's position in the earnings distribution.

There are of course elements of truth in each polar case, so that a synthesis of human capital formation choices, innate ability factors, and pure luck (including especially a careful choice of one's parents) is needed to explain the distributions of earnings and of income that may be observed in all countries. But since human capital formation is basic to the effects of education on earnings and hence on the income distribution, there follows a brief exposition of that.

2. Fundamentals of Human Capital Theory

In both competitive labor markets as well as many that are centrally-planned, earnings differentials reflect underlying skill differences: labor compensation varies directly with labor productivity. According to human capital theory, individuals may deliberately enhance their own productivity (and consequently, their earnings) by investing in their own human capital. Numerous possibilities for such self-investment exist, including not only

schooling and job training programs to acquire new skills, but also expenditures upon medical care to improve health and longevity, as well as acquisition of information about the location of higher-paying jobs. Recent research (Benson 1982) has stressed the importance of preschool education of the child at home (largely by the mother) as part of the human capital formation process. While initial studies narrowly focused upon investment in formal education, more recent work has widened the focus to examine the impact of all productive self-investments upon earnings, as well as the reasons for differential investment.

According to human capital theory an individual or family decision-unit selects an amount of schooling (or other self-investment) to maximize some objective function subject to some constraints. The objective function may be lifetime income, appropriately discounted, or it may be utility, a measure of well-being. The constraints include the limits imposed by a family's own financial resources, its capacity to borrow outside funds, and limits upon the time the individual student (and in earlier years the parents as well) can devote to education. Optimal investment in schooling occurs where the discounted value of the costs incurred equals the discounted value of the benefits expected. Costs include out-of-pocket payments plus earnings foregone. Benefits include the increase in expected lifetime earnings as well as nonpecuniary returns such as improved working conditions, job security, and the consumption benefits of education expected from future leisure-time activities.

3. Empirical Results from the Schooling Model

Following the schooling model of human capital theory developed by Jacob Mincer (1970), let Y_s equal annual earnings for an individual with s years of schooling. Let n equal the length of the working life and r equal the discount rate. The present value of earnings equals

$$Y_s \int_s^{n+s} e^{-rt} dt = \frac{Y_s e^{-rs} (1-e^{-rn})}{r}$$

If Y_o equals annual earnings in the absence of any schooling, the present value of this earnings stream equals

$$Y_o \int_o^{n} e^{-rt} dt = \frac{Y_o (1-e^{-rn})}{r}$$

By equating the two present values, we obtain an implicit solution for r, the internal rate of return of s years of schooling:

$$Y_s = Y_o e^{rs}.$$

In logarithms the equation becomes

$$\ln Y_s = \ln Y_o + r s. \qquad (1)$$

which states that percentage differences in schooling are strictly proportional to years of schooling, where the constant of proportionality equals the internal rate of return. One implication of eqn. (1) is that annual earnings will be more unequal than the underlying distribution of schooling. A second

is that for a symmetric distribution of years of schooling, earnings will be positively skewed. Finally, earnings inequality and skewness are greater the higher is the rate of return.

From an empirical vantage point, the explanatory power of eqn. (1) is quite low. Using cross-sectional US earnings data Mincer (1974) found R^2s as low as 0.10. However, when eqn. (1) is augmented by years of job experience (t) and weeks worked (w) such as

$$\ln Y_s = \ln Y_o + r\, s + \alpha_1 t - \alpha_2 t^2 + \alpha_3 W \qquad (2)$$

the goodness of fit improves substantially. For example, Mincer is able to explain 33% of the differences in earned income by differences in the amount of formal education (1974 p. 53). Altogether, after controlling for weeks worked, he explains in at least one census sample over 60 percent of the differences in earnings by use of the number of years of formal schooling (ignoring quality) and the years of experience, the latter interpreted as human capital formation on the job.

A slightly different approach has been taken by Paul Taubman (Atkinson 1976). Using longitudinal earnings data on former US servicemen, he identifies numerous sources of inequality including differences in formal education, college quality, mental ability, family background, work experience, health status, and nonpecuniary aspects of occupations. He concludes that after controlling for a wide variety of variables, education is still found to lead to large differences in earnings, although these

differences are no larger than those due to ability or family background differences.

A very large number of estimates of earnings functions (eqn. (2)), and of rates of return, covering many countries are now available. These international estimates have been summarized by Psacharopoulos (1981). In related work Psacharopoulos (1977) demonstrates that cross country differences in income inequality are highly correlated with the variance of educational attainment in these countries. Furthermore both educational inequality and earnings inequality are found to be much larger in less developed than in developed countries.

4. Life-Cycle Earnings and the Screening Hypothesis

In developed economies the age profile of earnings exhibits rapid growth during the first decade of work, followed by slower growth over the next few decades and finally zero or slightly negative growth as retirement approaches. In addition the spread in earnings across members of a particular age cohort widens as the cohort ages. These characteristics suggest that individual human capital stocks first increase through post school investment and then decrease through physical depreciation and technological obsolescence. The increasing inequality in earnings for a cohort over time suggests increasing inequality in human capital stocks as well. Dynamic optimization models (Ben-Porath 1967) explain human capital investment behavior over the life cycle consistent with this observed age profile of earnings. These models also explain why the earnings variance increases with age: if the more

educated are not only more efficient in the workplace, but also more efficient in acquiring human capital, then initial schooling differences will contribute to differences in post school investment behavior (Graham 1981). Changes in relative cohort sizes over time also may explain the increasing variance of cohort-specific earnings (Layard 1979 pp. S65-S97).

Human capital theory asserts that schooling and training are productivity enhancing activities. The screening hypothesis, in contrast, maintains that the main function of formal education is not to augment productivity but merely to filter or label existing productivity differences. Schools exist to administer tests in order to separate high ability individuals from those of lower ability. They assign grades and grant diplomas to label individuals for prospective employers who in turn may be willing to pay an earnings permium to properly screened high ability workers. The screening challenge to human capital theory has itself been challenged. If schools function only to label students, then surely a less costly, less time-intensive method of filtering could be found. Why, for example, could not a firm more effectively screen its own workers? Moreover, if diplomas serve as labels, why do students who stop just short of graduation earn nearly as much as students who do graduate? Layard and Psacharopoulos (1974) advance these and other criticisms of the screening hypothesis.

Out of this debate a consensus appears to be forming. Education serves both a productivity enhancing and labelling function, with the relative importance of each varying with the

level of education and the type of curriculum studied. Ultimately the screening challenge has benefitted human capital theory by enriching the basic schooling model to include the influence of other factors upon earnings.

5. Causes of Differences in Schooling

The major key to differences in earnings lies in the differences in the amount of schooling received. As has been suggested above, differences in both the quantity and quality of formal education, along with the related differences in human capital formation on-the-job, explain most of the observed differences in earnings.

Causes of differences in the amount of schooling among individual families can be divided into differences in the supply of opportunities and in differences in the investment-related demands for education. There are differences in the supply of opportunities (within a conceptual framework appropriate to the analysis of investment decisions) due to the differences in the supply of funds from state support and from family financial resources, both of which can limit (or expand) opportunities from the supply-side. There are differences in investment demands for education because of different expected net monetary and non-monetary returns at successive levels, differing ability to learn and hence to profit from further education, and differences among families and individual students in their planning horizons.

Factors Related to Demand

A model that tests for the relative importance of sources of differences in demand as compared to supply as determinants of differences in educational attainment has been estimated by McMahon (1983) for US students and their families. His results are consistent with those predicted by the Becker model (1975, pp. 94-144) in the sense that after controlling for differences in ability, the amount of further education planned is limited eventually by lower private rates of return at each higher educational level, due largely to increasing opportunity costs as the student goes further in school. This effect is illustrated in Fig. 1 by the downward sloping investment demand function, D_1D_1. That is, when the expected rate of return for each student (shown on the vertical axis) is expressed as a function of the amount of schooling planned, (shown on the horizontal axis) the private rate of return is lower for college then for high school, and lower for most graduate degrees than for two or four years of college. This rate of return is found to be a negative and highly significant determinant of years of schooling, controlling for other factors and using two-stage least squares to estimate the structural demand and supply equations to eliminate simultaneous bias.

Differences in ability, as measured by achievement test scores, which in principle would shift the investment demand outward, were found to have an insignificant effect on the amount of education chosen. McMahon (1983) also finds other factors on the demand side, such as a wide range of expected non-monetary

returns and the degree of uncertainty about expected returns to be of quite limited significance. However, after controlling for family income the education of the parents (especially the mother) does have a positive and significant relation to educational investment demand. This may reflect a somewhat longer planning horizon in families with more education.

Factors Related to the Supply of Educational Opportunities

The strongest and most significant effects are found to be those related to the availability of financial resources affecting the supply of educational opportunities available. Private capital markets are notoriously imperfect when attempts are made to borrow to finance human capital (in the absence of government guarentees). Therefore, internal family sources of funds, and public support of public schools, loom very important in determining whether or not educational opportunities are available. Lave et al (1981, p. 262) have found, for example, that the years of education actually available to Mexican peasants in each of 37 towns were of overwhelming importance in determining actual educational achievement, whereas "IQ contributed very little to explaining variance in educational achievement". McMahon's (1983) econometric estimates for the amount of education undertaken by US males find family disposable income to be highly significant. This shifts what was found to be an almost vertical supply-of-funds function to the right as illustrated in Fig. 1. The result is a larger amount of education chosen at E_2 (and hence I_2) by and for children who come from the higher income

families. The rate of return may be somewhat lower for these students (who are of equal ability when E_2 and E_1 are on the same demand function which controls for differences in ability), but their lifetime earnings are much larger.

Ability test scores are well known to be very highly correlated with parental income. This reflects the probability that children from higher income families are very likely to have had the advantages of the better schools found in higher income neighborhoods and school districts. This is very important in the US and in other countries that have a highly decentralized system of local or private schools that vary widely in quality (McMahon 1978). This correlation of ability test scores with parental income can also reflect differing home investments in children as developed by Leibowitz (1974) and Benson (1982). In less developed countries, children from low income families in rural areas also attend the poorest schools, with similarly adverse effects on their ability test scores. With this positive correlation between ability and family income, therefore, the demand for investment in education is further to the right for young people from higher income families because of their higher ability. This explains why students who both are from higher income families and have higher ability test scores tend to go the farthest in school (see E_3 or I_3 in Fig. 1).

6. Public Education Policies and Inequality

A myriad of government policies including tax and expenditure programs as well as policies on education have direct and

indirect, intended and unintended, effects upon the distribution of income. It is important therefore to consider the goals of such policies. Should government attempt to reduce the degree of earnings inequality (outcomes), or should it strive only to reduce inequality of opportunities? In general, redistributive income tax and transfer schemes are advocated by those who would have the government influence economic outcomes directly, while educational policies are favored by those who seek first to promote greater equality of opportunity. But clearly, these two goals need not be inconsistent: one effective way to promote greater earnings equality in the long run may be to promote greater equality of access to education in the short run. (Layard 1979 pp. S193-S212).

Inequality of educational opportunities is particularly acute in less developed countries. In Indonesia, for example, most children are withdrawn from school after grades 5 or 6 by their parents who want them to work on the farm and are not willing to bear the rising cost of foregone earnings. For this reason, the usual educational pyramid in such countries exhibits a wide base (most of the population with no more than a primary education) and narrow middle levels (fewer individuals with a secondary education and fewer still with higher education or advanced technical training). As such, the distribution of earnings tends to be highly skewed in these countries, with the benefits of technological progress accruing only to those in the nonagricultural sector at the top of the pyramid. If the benefits of progress are to be shared by all, the education and skills of

workers at the bottom of the pyramid need to be improved. This could be accomplished most directly by raising the age of compulsory schooling and redirecting government monies toward augmenting the quality and quantity of primary and secondary schooling.

In developed countries, inequality of educational attainment is less severe, but still significant. In the US, for example, 68.6 percent of the population 25 or more years old had graduated from high school by 1980, but only 17.0 percent were college graduates. To the extent inequality in educational attainment results not from inequality in native ability or other such demand factors, but from inequality on the supply side, the objective of federal education policies should be to minimize local differences in supplies of educational resources and opportunities by extending student loans and grants for higher education and improving the quality of public primary and secondary education.

Will greater equality of educational opportunities promote greater equality of earnings? The screening hypothesis and human capital theory provide two very different answers. According to the screening hypothesis, if employers cannot identify productivity differences among their workers, then in the absence of screening all workers would be paid the same. The result of schooling and labelling is to insure that higher ability individuals will receive higher earnings than less able workers. In this case an extension of schooling to all segments of society will only serve to filter individuals more finely and to make the distribution of labor earnings less equal. On the other hand, if

human capital theory is correct in asserting that schools function primarily to enhance worker productivity, then greater equality in schooling may lead to greater equality in earnings.

But even human capital theory would not go so far as to suggest that equality of opportunity necessarily engenders equality of outcomes. Differences in both luck and innate abilities abound. However, to the extent that some ability differences can be traced to differences in preschool parental training or differences in the quality of primary education, then publically provided educational programs affect not only the supply of opportunities but also student demand for advanced education. The "Head Start" program launched in the US in the 1960s was designed to augment the early training of economically disadvantaged preschool children who were receiving little preschool training at home. The objective of the program was to provide these children with skills that would improve their performance in primary school and thereby raise their effective demand for more advance education.

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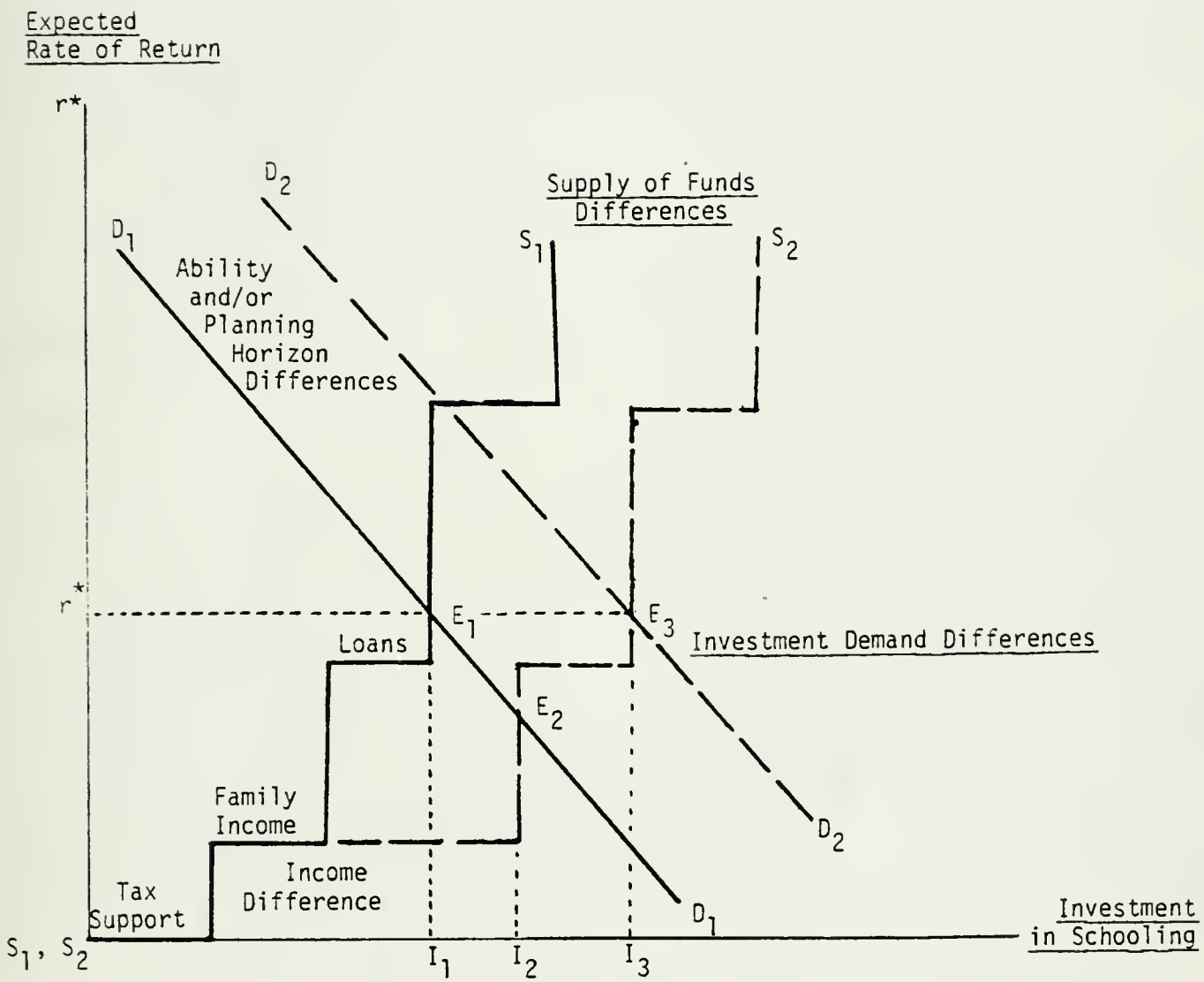

FIGURE 1. Differences in Supplies of Resources and in Demands Underlie Differences in Schooling