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RATES OF RETURN TO EDUCATION IN THE UNITED STATES: A THEORETICAL AND EMPIRICAL STUDY

Daniel C. Rogers

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INTRODUCTION

The economics of education is of great importance to the Kenyan economy. Therefore, the theoretical portions of this paper should be of general interest. However, the empirical work described herein concerns the United States and has but little applicability to Kenya. With this warning, I shall proceed, hopeful that no one will expect from the paper answers to problems with which it is not concerned.

The economics of education can be split into three categories as follows:

1. Manpower, which is basically a study of the supply of and demand for various types of labor over time;
2. "The residual factor," the name often given to the study of education as a factor of production, which derives from attempts to determine the contributions of various factors to increments in the output of an economy; and
3. The rate of return to "investment" in education. It is this third category of the economics of education with which this paper is concerned.

This paper has two purposes. The first is to present theoretical problems involved in interpreting the meaning of the rate of return to investment in education and in determining its size. The second objective is to estimate what that rate of return is in the U.S. The first two sections of this paper, "Education as Investment" and "Rates of Return", will deal with the theoretical aspects. The third section, "Past Studies," will be a transitional section dealing with the theoretical aspects of empirical work. The fourth section, "This Study," will describe the research I undertook on the question of returns to education in the U.S. The final section will present a short summary.

I. Education as Investment

In a world of scarcity alternative investments must be evaluated in order to allocate resources optimally. Such evaluation is made by comparing the costs and the benefits associated with any investment. This can be done by finding the present value of alternative investments at various interest rates or by comparing the internal rates of return, where the internal rate of return is the discount rate which equates the costs to the benefits. In any case, the value of the costs and the benefits must be known. In the case of education, the value of both differs for society and the individual.

The cost of capital is lower to government than to individuals. This is true in a real sense as well as the sense that government can print money, since the risk premium portion of the interest rate paid is so much smaller for government. On the benefit side, there are many externalities which society can capture from education. The social effects of education, as exemplified by the benefits to the nation of increased awareness of citizenship and nationhood, are one such externality. Also, the technical progress of the economy can be at least partially attributed to education. Unfortunately, the value of externalities is very difficult to measure. It is, however, less difficult to evaluate the relative value of externalities for sub-optimization decisions than for full optimization decisions. For example, it is easier to compare the externalities associated with another secondary school to those of a teacher's training college than to compare those of a college to those of a drainage system. Hence, it is easier to make assertions about allocation within education than to try to solve the grand resource allocation problem of determining how many resources should go into education in total. In developed countries, at least, educational expenditures have not been determined through cost-benefit analysis. Rather, the belief in the value of education for democracy and the general uplifting of society has been the determining factor in deciding the quantity of education.[1] Therefore, cost-benefit analysis is, in a certain sense,

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[1] Some assert that such analysis underlies decisions in this area, perhaps subconsciously. See Burton Weisbrod External Benefits of Public Education: An Economic Analysis (Princeton: Industrial Relations Section, 1964).

irrelevant to the grand resource allocation problem. However, this does not eliminate the value of the analysis for sub-optimization decisions.

From the private point of view, I would argue, investment in education is different from investment in physical capital. The greatest portion of investment in education consists of foregone earnings. In the U.S., e.g., this is at least true of every level above the age of required school attendance. Since a student's investment consists mainly of foregone earnings,[1] his income is lower than that of one who is not a student. As expenditures are to some extent a function of income and income is low for a student, his expenditures are lower than they would be if he were working. In addition, students traditionally have a low standard of living which makes it psychologically easier to live on a lower income. Figure 1 pictures the situation envisioned here. The worker has a larger earnings and saves much less than the student invests. What is being argued is that there is an economic irrationality or a psychological factor which makes it easier for an individual to invest in education than in physical capital. There is then, in education, a sort of forced savings. This suggests that the return to education from the individual's point of view may not have to be as great as that on capital in order for him to invest in it.

The fact that not all expenditure on education is investment from the standpoint of the individual adds weight to this opinion. At least some expenditure on education is for consumption purposes. One derives pleasures from the effects of education throughout one's life in the form of enjoying books, and so forth. That is consumption. While it is probably impossible

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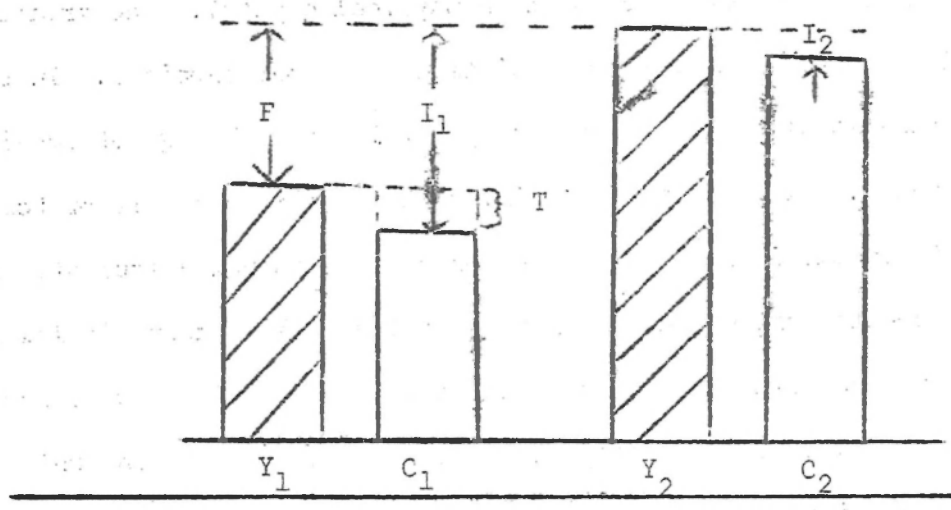
[1] TABLE 1: Costs of Education the the U.S.[a]

	Secondary (4 years)	College (4 years)
Foregone Earnings	$2,000	$7,000
Total Private Costs	2,000	9,000
Total Social Costs	3,000	10,000

[a]All costs are in 1957-59 prices. Costs are for education in 1936-39 for secondary school and 1940-43 for college.

FIGURE 1



1 = Student

2 = Full-time worker

Y = Earnings

C = Consumption

F = Foregone earnings

I = Investment

T = Tuition

Where: $I_1 = F + T = Y_2 - C_1$

$I_2 = Y_2 - C_2$

to determine the proportion of educational expenditure which is for consumption and the proportion for investment purposes. it is clear that treating all such expenditure as investment overestimates the size of the "investment."

II. Rates of Return

The above argued that investment in education is qualitatively different from investment in physical capital from the viewpoint of both society and the individual. There are also real differences in the costs and benefits which make the rates of return differ for the two.

For both society and the individual, foregone earnings make up the largest part of investment in education. For society, these measure the loss of labor which could have been put into the productive process. The proportion of this labor which actually would have been used for productive purposes depends on the general unemployment situation in the country. The probability of a 2nd standard "graduate" finding employment is low in both the U.S. and Kenya, but probably lower here; so there is but little loss to society when such a person stays in school. The probability of a university graduate being unemployed is close to zero in either country, so there is therefore a large loss to society if he stays in school. For the individual foregone earnings are also a cost since he is not earning money he could have earned. It is in direct costs of education that society and the individual differ.

For society all recurrent expenses -- teachers, materials, administrators, etc. -- as well as the depreciation of the buildings and other capital used in education are costs. For the individual the direct costs are only the tuition which must be paid and the cost of books, uniforms (above the cost of the clothes which would be worn in their stead), etc. In Kenya the direct costs are relatively high for primary and secondary schooling and relatively low for college compared to the U.S., where all schooling below college is free and many attend college with only nominal fees. In summation the cost to society is greater than to the individual in all cases.

The returns also differ somewhat between society and the individual. Society captures the benefits of the externalities associated with education, whereas the individual does not. In addition the individual does not receive all of the benefits of the greater earnings associated with more education. This is due to the taxing policies of most countries. That is, some of the gains are taxed away via income taxes. When comparing private returns to investment in education to other investments, this is not very important in that all earnings are taxed. But to the extent that the taxes on these differ, the value of one investment as compared to another is affected. In addition, if one is concerned with the return to education, per se, in considering for example, a loan program for financing education, taxes are a relevant consideration.

I shall now turn to a brief survey of the attempts to quantify the returns to education which have been made in the past, followed by my own study.

III. Past Studies

The research on the returns to education can be broken into two categories: those that use tabulation studies and those that use case studies. I shall discuss them in that order.

The pioneering work in the returns to education was done by Glick and Miller[1] and followed up by further work by Miller.[2] Glick and Miller took Census data of median income by age, race, sex, and education for the population in 1949. They determined the expected lifetime incomes of individuals with various amounts of education using mean incomes for each age group multiplied by the probability of being alive at that age.[3] To determine the "return" to education they merely subtracted the lifetime income of those with one level of education from the income of those with a greater amount of education. This is the source of the oft quoted, "A college education is worth $100,000." They then proceeded to estimate the cost of college education to the individual and to show that that amount invested in government bonds would not yield as much as the increment in income associated with greater education.

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[1] Glick, Paul C. and Miller, Herman P. "Educational Level and Potential Income", American Sociological Review, 1956, pp. 307-12.

[2] Herman P. Miller "Annual and Lifetime Income in Relation to Education: 1939-59", American Economic Review, December 1960, pp. 963-86 and "Lifetime Income and Economic Growth", American Economic Review, September 1965 pp. 833-44.

[3] They apparently used a formula such as the following, after mean income had been estimated from the median:

$$Y_j = Y_{j(22-24)} \sum_{i=22}^{24} \gamma_{ij} + Y_{j(25-29)} \sum_{i=25}^{29} \gamma_{ij} + Y_{j(30-34)} \sum_{i=30}^{34} \gamma_{ij} +$$

$$Y_{j(35-44)} \sum_{i=35}^{44} \gamma_{ij} + Y_{j(45-54)} \sum_{i=45}^{54} \gamma_{ij} + Y_{j(55-64)} \sum_{i=55}^{64} \gamma_{ij} + Y_{j(65-74)} \sum_{i=65}^{74} \gamma_{ij}$$

Where: Y_j = lifetime income of the jth educational level

$Y(i - i+n)j$ = mean income of age group from i to i+n for the jth educational group.

γ_{ij} = probability of someone in the jth educational level and 22 years of age surviving to i years of age.

There are several problems with this procedure the discussion of which will be instructive when considering other studies. First of all, the basic piece of datum is income rather than earnings. Since education is positively correlated with family wealth and family wealth is positively correlated with income from sources other than earnings(e.g., inheritance), income from sources other than earnings is positively correlated with education. Thus, the use of income instead of earnings probably overstates the benefits to be derived from education since education receives credit for creating income which is actually due to the greater family wealth of the more highly educated. Secondly, no other variables are considered. Therefore, to the extent that those who have more education are different from those who have less in other ways which affect earnings, the relationship between earnings and education is misspecified. Particularly important in this regard are such factors as social class, ability,and the quality of education. Since all of these factors can be assumed to be positively correlated with education, again the value of education is overstated. Thirdly, the study is based on one year's experience. In order for this to be sufficient for the purposes at hand, the economy would have to remain exactly the same in terms of the relative supplies and demands for labor with each amount of education and there would have to be no growth in the economy (or labor would have to receive no part of any growth). Finally, neither the costs nor the benefits were discounted and no internal rate of return was computed. Thus, it is difficult to come to any conclusions based on their data. Miller's later work, however, does bring into the analysis some of the effects of changes in and growth of the economy. Hansen, using the same sorts of data, computed the internal rate of return to investment in education.[1] His findings will be discussed later. His data unfortunately, suffer from the same failings that Glick and Miller's do.

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[1] W. Lee Hansen, "Total and Private Rates of Return on Investment in Schooling," Journal of Political Economy (April 1963), pp. 128-140.

Case studies are more satisfying in that one can directly control for variables which might be correlated with education and earnings. There have been several of these in the U.S. in the last decade beginning with Wolfle and Smith's work[1] and followed by Morgan and David,[2] Adams,[3] Hunt,[4] Hirsch and Segelhorst,[5] and Hanoch.[6] The Wolfle-Smith study traces and administers a questionnaire to a group of secondary school graduates some 15 years after their graduation. The data from the questionnaire are supplemented by information from the school records on class rank and/or IQ. This could have been an excellent study but very little of the data is actually used. In addition, their study is limited by only being able to deal with the benefit of college education from the standpoint of a secondary school graduate and by having earnings data from only one year.

Hunt uses a survey of all college graduates in the U.S. for his basic data. Through an ingenious, although tenuous proceedure, he estimates the ability of the individuals. He has extensive data on the socio-economic background of the group. Using a multiple regression analysis, he determines the controlled effect of education on earnings. This study, too, suffers from having earnings data from but one year on which to base lifetime earnings.

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[1] Dael Wolfle and Joseph G. Smith, "The Occupational Value of Education for Superior High-School Graduates," Journal of Higher Education, 27 (April 1956), pp. 201-212.

[2] James N. Morgan and Martin David, "Education and Income," Quarterly Journal of Economics, 77 (August 1963), pp. 423-437.

[3] F. Gerard Adams, "The Size of Individual Incomes: Socio- Economic Variables and Chance Variation," Review of Economics and Statistics, 40 (November 1958), pp. 390-98.

[4] Shane J. Hunt, "Income Determinants for the College Graduate and Return to Educational Investment," Yale Economic Essays, 3, (Fall 1963), pp. 305-58.

[5] Werner Z. Hirsch and Elbert W. Segelhorst, "Incremental Income Benefits of Public Education," Review of Economics and Statistics, 47 (November 1965), pp. 392-99.

[6] Giora Hanoch, Personal Earnings and Investment in Schooling, unpublished Ph.D. Dissertation (University of Chicago 1965).

The Morgan-David and the Hanoch studies have additional interesting features. The former uses questionnaires administered to a probability sample of the population of the U.S. It has extensive data but lacks a good ability measure, an educational expenditures measure, and earnings data for more than one year. The Hanoch study, which uses the extensive questionnaire administered to the U.S. Census' 1 in 1000 sample of the population, suffers from the same failings as does the Morgan-David study. The other studies mentioned above are combinations of the techniques and data already described so they will not be discussed.

To summarize this section, many studies have been undertaken to determine the relationship between education and earnings. All of the studies suffer from having to depend on earnings data for one year, all but one have no, or inadequate, ability measures, and almost all deal with only college education. These are some of the inadequacies that my study was designed to avoid.

IV. This Study

A. The sample

The selection of the sample was undertaken with several objectives in mind. First, IQ data had to be available for each person. Second, they had to be a group which would cover a whole population. That is, they had to be selected at a young enough age so that few had dropped out of the educational stream, since, to the extent that such drop outs were different from those who continued, this would bias the sample. Third, the group should now be as old as possible so that they would have a long earnings history and be at or near their peak earnings capacity. A second consideration leading to the desire for a group which is now older was the hope of minimizing the interference of World War II on the educational history. The best that I could do to meet these objectives was the selection of an eighth grade group in several Connecticut cities in 1935. These people were about 45 years old at the time of the survey and many of them were able to complete college without interference from the war. I was not able to find a group for whom the war would not have been a large factor in their educational and vocational careers.

Full classes for two of the largest cities in Connecticut were used as well as the academic stream from another city and full classes of four private schools. The latter two groups were included in order to have a larger representation from the wealthier and higher intelligence groups of the society.[1] In all, 1827 individuals were included in the group. It was attempted to trace these people through the use of city directories, parents' names, alumni class records, and any other information available on the school records. Three rounds of questionnaires were sent out to each person, if necessary, The results of these mailings follow.

B. Response and biases

Of the group selected, some sort of address (or information that they were deceased) was found for 73%. Of these, responses (filled out questionnaires, refusals, or information that they were deceased) were received from 35%. This represents 26% of the original group. After some responses were eliminated for one reason or another, 364 were left and constitute the sample.

Through data taken from the school records, comparisons of the responses on the three rounds of mail sent out, and Census data, I was able to test the accuracy of some of the responses and determine biases in others. On the whole, the answers seemed to be reasonably accurate. One of the most important sets of questions was about earnings over a 15 year period. A separate survey was undertaken to determine the accuracy of responses to this type of question. This second survey asked that same set of questions as on the main questionnaire of a group of people for whom the answers were known. The results, although for a small select group (they all worked for the same employer), strongly suggested that the accuracy of response did not deteriorate as the time between the fact and the question grew longer. In general the answers seemed to be sufficiently reliable to be used.

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[1] Many well to do parents in New England send their children to private schools. This is much more frequent in New England than elsewhere in the U.S.

The responding group was biased in several identifiable respects. They were better educated, had higher IQ's,and had larger earnings than those who did not respond. The IQ's could be and were tested directly as this datum was available for the respondents and non-respondents alike. The respondents were found to have statistically significantly higher IQ's. Using a comparison of the respondents on the various rounds under the assumption that the later the round the more like those who did not respond at all the individual was, it was found that the earnings and education were biased upward. To the extent that the upward biases in earnings was a results of the upward bias in IQ and education, this does not effect the results. However, it appeared that the upward bias in earnings was larger enough to be an independent bias. If that is true, any estimates of the rate of return to education is likely to be biased upward.[1]

C. The variables

The variables used and their definitions can be seen in Table 2. They are broken into six categories Background, geographic, education, motivation, ability, and earnings. The analysis is done through multiple regressions with earnings as the dependent variables(regressands)and the first five groups listed above as independent variables (regressors). The variables used in the "Final Regression" were chosen in the following manner. The first group of variables was introduced into the regression. All variables which were found to have coefficients which were insignificantly different from zero were dropped and the next group of variables was added. This was repeated, with the exception of the formal education variables, until all variables had been considered. Then, variables which at one stage had had significant coefficients, but had subsequently dropped out as other variables were added, were reintroduced into the equation for a final test.

The education variables were kept in the equation even though most of their coefficients were insignificantly different from zero because the coefficients in any case are maximum likelihood estimates of the effect of the variable. This together with the fact that education is of key importance to the analysis, lead me to leave them in the equation.

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[1] Even this would not necessarily mean an upward bias in the rate of return. If there is an upward bias in earnings at each education level, they might cancel each other out since the rate of return to education is calculated by subtracting the earnings of people at one level of education from those at another.

TABLE 2: Quantification of Variables

A. Background Variables

1. BP -- Grew up with both parents (2): 1 if no; 0 if yes.
2. SC -- Social class: 1 highest; 5 lowest.
3. NB -- Both parents native born (2): 1 if true; 0 if false.
4. FL -- Foreign language spoken at home, often or exclusively (2): 1 if no; 0 if yes.
5. VT -- Veteran of military service: 1 if yes, 0 if no.
6. RC -- Catholic (2): 1 if true; 0 if false.
7. RJ -- Jew (2): 1 if true; 0 if false.
8. OR -- Other religion, except Protestant (2): 1 if true; 0 if false.

B. Geographic Variables

9. NS -- Region of the United States: 0 if not the South; 1 if South.
10. C1 -- Place of residence less than 10,000 population: 0 if true; 1 if false.
11. C2 -- Place of residence 175,000 or greater: 1 if true; 0 if false.
12. C3 -- Place of residence 500,000 or greater: 1 if true; 0 if false.

C. Education Variables

13A. E1A -- 1 if 8th grade or higher: used when the formal education variables (E1-E6) are conjoint with another variable.
13. E1 -- 1 if 9-11th grade or higher; 0 otherwise.
14. E2 -- 1 if 12th grade or higher; 0 otherwise.
15. E3 -- 1 if 1-3 years of college or higher; 0 otherwise.
16. E4 -- 1 if college degree or higher; 0 otherwise.
17. E5 -- 1 if 1 year of graduate school or higher; 0 otherwise.
18. E6 -- 1 if second degree of higher received; 0 otherwise.
19. OE -- Technical school, on the job training, military training: 1 = 1-6 months; 2 = 7-12 months; 3 = 1-1½ years; 4 = 1½-2 years; 5 = 2-2½ years; 6 = 2½-3 years; 7 = 3-3½ years; 8 = 3½-4 years; 9 = more than 4 years.
20. PS -- Attended a private school: 1 if yes, 0 if no.
21. EX -- Educational expenditure index; United States average = 1.

D. "Motivation" Variables

22. MR -- Married: 1 if no, 0 if yes.
23. JB -- Has more than one job: 1 if yes; 0 if no.
24. FT -- Employed full-time: 1 if yes, 0 if other than full-time (part-time, occasionally, unemployed, or retired).
25. MG -- Migrated: 1 if yes; 0 if no.

E. Ability Variables

26. AG -- Age corrected for class: in years.
27. IQ -- IQ: in Otis IQ point equivalents.
28. GD -- Average grade at highest level of schooling: 1 = F; 2 = F's and D's; ...; 9 = A.
29. SH -- Severe mental or physical handicap: 1 if yes; 0 if no.
30. LH -- Light or medium handicap: 1 if yes; 0 if no.

F. Earnings Variables

31. LY65 -- Natural log of 1965 earnings.
32. LYL0 -- Natural log of lifetime earnings discounted to 1936 at 0%.
33. LYL4 -- Natural log of lifetime earnings discounted to 1936 at 4%.
34. LYL8 -- Natural log of lifetime earnings discounted to 1936 at 8%.

(2) Variable tested with a two-tail test.

Some of the variables are deserving of more comment as to their formulation and the method of presenting them in the regression equation. I shall discuss earnings, education, educational expenditure, grades, and social class in that order.

Earnings were estimated in three portions: from 1936 (the first year after the selection of the group) to 1949, from 1950 to 1965, and from 1966 to 1985 (the expected retirement age). The earnings during the first period were estimated from information on each individual's 1950 earnings, his military experience (years of service and rank upon leaving), his length of education, and the trend of earnings and unemployment during the years he was in the labor force. The second period was estimated from the answers to the questions on 1950, 1955, 1960, and 1965 earnings. In general, it was assumed that their earnings during the intermediate years followed a linear trend between each pair of benchmarks. Those four years were typical of the path of GNP in the U.S. for that period and are therefore well suited for estimating earnings over that period. Finally, the last period was estimated from the individual's 1965 earnings and Census data of earnings by age, race, sex, and occupation. The estimation procedure was to find at what percentile of the earnings distribution for the individual's occupation and age group he was in 1965. Then the earnings of those at the same percentile of the earnings distribution for each older group were assigned to him as his earnings at that age, account being taken for the expected growth of the economy. Putting these three together, an estimate was derived for lifetime earnings for each individual.

There are other problems with earnings. Firstly, for the self-employed a percentage of invested capital had to be deducted from earnings. Secondly, not all remuneration is in the form of salary or wages. The data I gathered on fringe benefits, unfortunately, turned out to be not reliable enough to use in the analysis. Finally, earnings were entered into the regression as log of earnings which helps prevent heteroscedasticity.

Formal education was brought into the regression as a group of dummy variables. Putting them in as a single variable (for example, grade 8 equal 1, grade 9 equal 2, etc.) would force the effect of education into a linear form. This would be the same as equating a year of primary school

to a year of post-graduate school, something which obviously should be avoided. The group of dummy variables allows each level of education to have an independent effect on earnings.

Educational expenditure was entered into the regression equation as an index so that the size of the variable was not dependent upon the amount of education. If total expenditures were used, it would just be a proxy for total education. Marks (grades) at highest level of schooling completed (e.g., secondary school or college) was one measure of ability. It was very unsatisfactory as the number of years covered was large, memories are imperfect,and averaging methods differ.

Social class is an important variable since it influences the amount of education received, vocational opportunities when finished with school, and ambitions for one's life. The Hollingshead "Two Factor Index"[1] of social class was used here. This uses a weighted average of father's education and father's occupation to determine social class.

Those are the major variables which are not straigntforward in their formulation and meaning. I will next discuss a few variables which could have been entered into the regression equation but were not.

As was mentioned above, fringe benefits is one factor which it would have been desirable to have used, but the information gathered was not sufficient to allow its inclusion. In addition, there are two variables which could have been included but were deliberately left out: self-employment and occupation. Since part of the benefit derived from education is vocational opportunity, more specifically, since certain types of education open up occupations which are otherwise inaccessable, including either of these variables would take away from the monetary benefits which are actually attributable to education. Several of the studies which were discussed above do use these variables and therefore their results are additionally suspect.[2]

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[1] August B. Hollingshead, The Two Factor Index of Social Position (mimeo , 1957).

[2] The Morgan-David, Hunt, Hirsch-Segelhorst, and Hanoch studies use self-employment and the Adams, Morgan-David, Hunt, and Hirsch-Segelhorst studies use occupation.

D. The Analysis

The final Regression was run in several forms. It was run with the education variable as described in Table 2. It was also run with the set of education variables multiplied by IQ, in one case, and by IQ times the educational expenditure index in another case (the results of this latter form can be seen in Table 3.) These latter two sets of regressions were run because IQ and educational expenditures did not have coefficients significantly different from zero when entered into the regression equation on their own. Entering these two variables in combination with education allows them to effect earnings differently for different levels of education. For example, a given number of IQ points can affect earnings for those with only an eighth grade education differently from those with a college education. It was found that the third form mentioned, education times IQ times expenditure, had a statistically significantly higher coefficient of determination (R^2) than either of the other forms; therefore attention is concentrated on the results of that set of regressions.

From the estimated regression equation it is a fairly simple matter to calculate the effect of additional education, ceteris paribus. Each of the variables other than education is set at the sample mean and multiplied by its coefficient. When these are summed and added to the intercept, the base value is known. Adding the coefficient of the first education variable gives the log of the earnings of those who had the lowest level of education (when the education-expenditure-IQ form is used, the coefficient for the first education variable is multiplied by the mean of IQ times the mean of expenditure). The antilog of this figure gives the predicted earnings of those at this level of education. Repeating the process for the next level of education gives an estimate of the earnings of those with that amount of education (see Table 4 for the value of lifetime earnings for those with a variety of different IQ's and expenditures). The difference between the two is the amount attributable to that increment in education.

Table 3: Variables from "Final Regression" with E1A-E6 Being Education Times IQ Times Expenditure[a]

		1965 Earnings	1936-1985 Earnings Discounted to 1936 at:		
			0%	4%	8%
Intercept		7.87119	14.34543	13.27198	12.23725
Variables					
2.	SC	-.05839 (.04039)	-.06147* (.02365)	-.05608* (.02089)	-.04409* (.01857)
6.	RC	.13845 (.08858)	..13908** (.05187)	.12260** (.04581)	.10331** (.04072)
7.	RJ	.58771** (.19648)	.39756** (.11505)	.36840** (.10161)	.32308** (.09032)
13A.	E1A	-.00084 (.00247)	-.00103 (.00145)	-.00028 (.00128)	-.00083 (.00113)
13.	E1	.00094 (.00222)	.00086 (.00130)	.00057 (.00115)	.00019 (.00102)
14.	E2	.00025 (.00079)	.00040 (.00047)	.00011 (.00041)	-.00028 (.00037)
15.	E3	.00134 (.00116)	.00126* (.00068)	.00107* (.00060)	.00086 (.00053)
16.	E4	.00097 (.00124)	.00207* (.00073)	.00149* (.00064)	.00073 (.00057)
17.	E5	-.00096 (.00265)	.00014 (.00155)	-.00005 (.00137)	-.00020 (.00122)
18.	E6	.00512* (.00283)	.00155 (.00166)	.00128 (.00146)	.00087 (.00130)
20.	PS	.27052 (.18953)	.15465 (.11098)	.12982 (.09801)	.09538 (.08712)
22.	MR	-.60552* (.15057)	-.43866* (.08817)	-.37302* (.07787)	-.30124* (.06921)
23.	JB	.26849* (.09685)	.05753 (.05671)	.01847 (.05009)	-.01629 (.04452)
24	FT	2.49117* (.36989)	.57995* (.21659)	.33077* (.19129)	.11034 (.17003)
26.	AG	-.03285 (.03577)	-.04427* (.02094)	-.03677* (.01850)	-.02824* (.01644)
29.	SH	-.79480* (.27329)	-.02459 (.16002)	.01853 (.14133)	.04985 (.12562)
R^2	=	.36	.40	.34	.23
F Ratio	=	12.23[b]	14.38[b]	11.37[b]	6.55[b]

*Tested with a one-tail test; significant at the 5% level.
** Tested with a two-tail test; significant at the 5% level.
[a]The standard error is in parentheses below each coefficient.
[b]Equation significant at the 5% level (1.67 is the minimum value for significance).

TABLE 4: Mean Earnings by Education Calculated from Table 3 with IQ and Expenditures Set at Alternative Levels

	A			B			C		
	IQ.EX = 185.278 (IQ and Expenditure Each One σ above Its Mean)			IQ.EX = 121.093 (IQ and Expenditure Each at Sample Mean)			IQ.EX = 106.159 (IQ One σ below Its Mean, Expenditure at Its Mean)		
	1936-85 Discounted to 1936 at:			1936-85 Discounted to 1936 at:			1936-85 Discounted to 1936 at:		
	(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
	0%	4%	8%	0%	4%	8%	0%	4%	8%
Education	(000)	(000)	(000)	(000)	(000)	(000)	(000)	(000)	(000)
Grade									
8	$ 320.3	$134.2	$ 73.6	$342.4	$136.6	$65.3	$347.5	$137.2	$64.5
9-11	375.5	149.2	76.2	379.8	146.4	66.8	380.5	145.8	65.8
12	404.5	153.2	72.3	398.7	148.3	64.6	397.2	147.5	63.9
College									
1-3	510.9	185.6	82.8	465.7	169.0	71.7	454.1	165.2	70.0
4	749.7	244.5	97.1	598.3	202.3	78.3	565.7	193.6	75.7
Grad. or Prof. School									
No Degree	769.4	242.4	93.6	608.3	201.2	76.4	574.2	192.5	74.1
Degree	1035.0	307.3	108.8	783.4	235.0	84.9	676.9	220.6	81.4

TABLE 4: Mean Earnings by Education Calculated from Table 3 with IQ and Expenditure Set at Alternative Levels, cont.

	D			E		
	IQ.EX = 78.097 (IQ at Its Mean, Expenditure One σ below Its Mean)			IQ.EX = 69.929 (IQ and Expenditure Each One σ below Its Mean)		
	1936-85 Discounted to 1936 at:			1936-85 Discounted to 1936 at:		
	(1)	(2)	(3)	(1)	(2)	(3)
	0%	4%	8%	0%	4%	8%
Education	(000)	(000)	(000)	(000)	(000)	(000)
Grade						
8	$357.7	$138.2	$63.0	$360.7	$138.2	$62.6
9-11	379.9	144.7	64.0	379.8	144.3	63.5
12	394.7	145.9	62.6	394.0	145.4	62.2
College						
1-3	435.5	158.6	67.0	430.2	156.0	66.1
4	511.9	178.1	70.1	497.2	174.2	69.6
Grad. or Prof. School						
No Degree	517.6	177.4	69.8	503.1	173.3	68.6
Degree	584.1	196.1	74.7	559.6	189.5	72.9

The differentials in earnings attributable to differentials in education are compared in several ways. The absolute differences are calculated. In addition, the relative advantages are determined. Probably most importantly, the internal rates of return are calculated by comparing the absolute differences in earnings at different discount rates to the costs of the education "creating" those earnings differences in order to find the rate which equates the costs and returns. The results of these calculations will be discussed next.

E Results

All of the analysis was carried out using three alternative rates (zero, four, and eight percent) for discounting both costs and benefits of education. Depending on one's concept of the opportunity cost of capital, one can make his own judgements as to the proper rate to use in calculating the present value of educational benefits. When calculating the internal rate of return, all of the rates are used. The effect of increasing the discount rate can be seen in Table 4. As the discount rate is increased, the lifetime earnings are drastically reduced. This is caused by the fact that the differential in earnings between persons with more education and persons with less is negative in the first years and this is recouped over a long period of time. Since the early "benefits" of education are really costs and are not greatly discounted, they are relatively large. In addition, many of the benefits are accrued many years after the fact and are therefore discounted greatly.

Table 5, which is derived from Table 4B, shows that the improvement in earnings as measured by the ratio of earnings of those with more education over those with less education, decreases markedly with increased discount rates. Thus, if one has a low time preference or a low cost of capital, the returns to education as measured by the present value of the difference between costs and benefits are considerable. However, if one has a high discount rate or capital is only available at a high price, education becomes less attractive as an investment.

Table 4 shows that when IQ and/or expenditure on education are increased, the lifetime earnings and the earnings increment associated with more education both increase in most cases. In the case of,

for example, post-graduate degree holders, when expenditures and IQ are each set at their means plus one standard deviation as opposed to their mean minus one standard deviation, lifetime earnings are almost doubled.

The ratio of the earnings of secondary school(twelfth grade) graduates to primary school (eighth grade) graduates at an eight percent discount rate is .99 as can be seen in Table 5. This might be taken to suggest that secondary school education does not "pay". This, however, is not the correct interpretation. Actually, this means that there is almost exactly an eight percent return on the private costs of that education, the foregone earnings. This can perhaps be more easily seen on Table 6.

Table 6 shows the internal rates of return over costs for all the people and all levels of education covered in this survey. Two figures are given for each increment in education. The first is for a low estimate of direct costs and the second for a high estimate as explained at the bottom of the table.

There are several interesting things to note in Table 6. Firstly, the internal rates of return over costs are only marginally different between the high and the low cost estimates. This is due to the often emphasised factor that direct costs are a minor portion of the total costs of education. It should be mentioned that these rates of return are either interpolations between zero, four, and eight percent or extrapolations beyond eight percent. In all cases, they have been rounded to a full percentage point, as can be seen. Thus, the difference between eight and nine percent, for example, might be spurious.

Secondly, the lowest internal rates of return are for "some graduate or professional school but no degree" over a college degree (4 years) and 12th grade over 10th grade. The former result is consistent with most studies of returns to education. This might be due to personality traits of those who begin and are not able to finish post-graduate education. On the other hand, it might be due to the nature of the motivation which leads one to plan on starting and not finishing such studies.

TABLE 5: Ratios of Earnings by Education Calculated from Table 4

Ratios	1965	1936-85 Discounted to 1936 at: 0%	4%	8%
8th Grade	$7,170	$342,400	$136,600	$65,300
12th / 8th	1.15	1.16	1.09	.99
Col. Deg. / 8th	1.53	1.75	1.48	1.20
Col. Deg. / 12th	1.32	1.50	1.36	1.21
2nd Deg. / 12th	2.19	1.83	1.58	1.31
All Col. Grads / 12th	1.67	1.64	1.46	1.25

TABLE 6: Privated Internal Rates of Return to Education Calculated from Table 4B[1, 2]

From / To	Grade 8	Grade 10	Grade 12	College 2	College 4	Grad. or Prof. School No Degree
Grade:						
10	8, 7					
12	7, 6	5, 4				
College:						
2	10, 9	10, 9	11,10			
4	10, 9	10, 9	11,10	11,10		
Grad. or Prof.:						
No Degree	9, 9	9, 9	10,10	9, 9	3, 2	
Degree	10,10	11,10	12,11	11,10	9, 9	13, 12

1. The first figure in each cell is for the estimate of costs equal to three times the national average in the case of higher education and private school costs in the case of grades 8-12. The second figure is for costs at the national average for higher education or zero for grades 8-12.
2. IQ and expenditure are set at the sample means.