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TOTAL AND PRIVATE RATES OF RETURN TO INVESTMENT IN SCHOOLING¹

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THE costs of schooling and the money returns resulting from investment in schooling are currently receiving more and more attention by economists, not only because of their possible implications for economic growth, but also because they may help individuals to determine how much they should invest in the development of their own human capital. This note provides some further evidence on these two topics; it presents estimates of internal rates of return based on both total and private resource costs for various amounts of schooling, from elementary school through college.

The fragmentary treatment of both the costs of schooling and the money returns to schooling found in much of the recent literature provided the stimulus for preparing these internal rate-of-return estimates. For example, Miller calculates life-time income values by level of schooling,² Houthakker estimates, on the basis of alternative discount rates, the present value of income streams associated with different levels of schooling,³ Schultz provides estimates of total resource costs

of education by broad level of schooling,⁴ and Becker and Schultz calculate for several levels of education the expected rates of return, sometimes on a total resource cost basis and at other times on a private resource cost basis.⁵ Given this diversity of treatment, it is difficult to obtain an over-all picture of the relationship among rates of return to different amounts of schooling or to see the nature of the differences between the rates of return as viewed by society and those viewed by individuals. Moreover, the relationship among the various methods of contrasting the economic gains from education—the lifetime income, the present value, and the rate of return comparisons—has been obscured.

It becomes important to understand what some of these relationships are when society and individuals allocate such a large portion of their resources to schooling. At the societal level, for example, we might be interested in determining whether to allocate more funds to reduce the number of dropouts from high school or to stimulate an increased flow

¹ This paper was completed while the author held a postdoctoral fellowship at the University of Chicago. The comments of T. W. Schultz, M. J. Bowman, L. C. Hunter, and H. L. Miller are gratefully acknowledged.

² Herman P. Miller, "Annual and Lifetime Income in Relation to Education: 1929-1959," *American Economic Review*, L (December, 1960), 962-86.

³ H. S. Houthakker, "Education and Income," *Review of Economics and Statistics*, XLI (February, 1959), 24-28.

⁴ Theodore W. Schultz, "Capital Formation by Education," *Journal of Political Economy*, LXVIII (December, 1960), 571-83.

⁵ Gary S. Becker, "Underinvestment in College Education?" *American Economic Review*, L (May, 1960), 346-54; and Theodore W. Schultz, "Education as a Source of Economic Growth" (Economics of Education Research Paper, August 15, 1961) (Mimeographed), and "Education and Economic Growth," *Social Forces Influencing American Education*, ed. H. G. Richey (Chicago, 1961). It should be noted that Schultz uses a short-cut method to derive his rate of return estimates.

of college graduates. As individuals, we would more likely be concerned with deciding whether to continue or to terminate our schooling, on the basis of the relative costs that will be incurred and the benefits that will accrue. To this end, the comprehensive sets of internal rates of return developed here should be useful as a first approximation in seeking answers to questions of this kind.

At the outset, it should be made clear that the measured rates of return are money rates of return; any other costs and benefits associated with schooling are excluded from consideration. In addition, there are problems of measurement, many of which have not been resolved, that make the estimation of even direct money rates of return difficult. Some of these difficulties are discussed in Part I, which outlines the methods and data employed. Part II presents evidence on rates of return to total and to private resource investment in schooling. Part III contrasts three different methods of measuring the economic gains to schooling, while Part IV offers some concluding comments.

I. ESTIMATION PROCEDURES

To estimate internal rates of return to investments in schooling, we require data on costs—total resource costs and private resource costs—for various levels of schooling as well as data on age-income patterns by each level of schooling. From these, life-cycle cost-income streams can be established that show for each level of schooling the flows of costs incurred during schooling and the subsequent flows of additional income that can be attributed to that schooling. The internal rate of return is then estimated by finding that rate of discount that equates the present value of the cost outlays with the present value of the additional income flows.

The basic source of income data is the *1950 Census of Population*,⁶ which provides distributions of income for males by age and level of schooling in 1949. From these, average income figures can be calculated for each age-schooling category, as shown in Table 1. Although Houthakker had previously presented such figures, his method of estimation produces a rather peculiar bias.⁷ In addition, Houthakker's data show mean incomes of all males over age fourteen, whether they were receiving income or not. But to the extent that only income recipients are represented in the data shown here in Table 1, most of the males outside the labor force, either because of school attendance (younger males) or retirement (older males), are probably excluded. Exclusion of these groups seems likely to provide better estimates of the age-income profiles, particularly at their extremities.

In order to make the task of estimating the rates of return more manageable, the age-income profiles were assumed to commence at the "average" age of completion of each level of schooling.⁸ For those with one to four years of schooling, the average amount of school completed was

⁶ United States Bureau of the Census, *1950 Census of Population, Special Report*, P.E. No. 5B, *Education*, Table 12.

⁷ The mean income figures used in this study were estimated by weighting the mid-values of each income size class by the numbers of income recipients in each size class, for each age-level-of-schooling category. A value of \$20,000 was used for the mid-value of the open-ended class. Houthakker used a "representative" income in his weighting, in order to take account of the skewness. However, such a procedure superimposes the skewness of the entire distribution upon each age-level-of-schooling category; this leads to serious problems, particularly at the younger age levels, where the resulting mean income values will substantially overstate the "correct" values.

⁸ This is an oversimplification, but it did not seem worthwhile to deal with this in a more detailed fashion.

taken as two years; hence the age-income profile for this group was assumed to begin at age eight. For the next group, those with five to seven years of school, six years of schooling were assumed, so that its age-income profile begins at age twelve. The other level of education groups and the ages at which their age-income profiles were assumed to begin are as follows: eight years, age fourteen; one to three years of high school, age six-

estimating total resource costs have been set forth by Schultz.¹⁰ Total resource costs include (1) school costs incurred by society, that is, teachers' salaries, supplies, interest and depreciation on capital, (2) opportunity costs incurred by individuals, namely, income foregone during school attendance, and (3) incidental school-related costs incurred by individuals, for example, books and travel. Private resource costs include the

TABLE 1
AVERAGE INCOME BY AGE AND YEARS OF SCHOOL COMPLETED,
MALES, UNITED STATES, 1949

AGE	YEARS OF SCHOOL COMPLETED							
	0	Elementary School			High School		College	
		1-4	5-7	8	1-3	4	1-3	4+
14-15. . . .	\$ 610	\$ 350	\$ 365	\$ 406	.....	.....	.....	.....
16-17. . . .	526	472	514	534	\$ 429	.....	.....	.....
18-19. . . .	684	713	885	1,069	941	\$ 955	.....	.....
20-21. . . .	944	1,009	1,216	1,535	1,652	1,744	\$1,066	.....
22-24. . . .	1,093	1,227	1,562	1,931	2,191	2,363	1,784	\$1,926
25-34. . . .	1,337	1,603	2,027	2,540	2,837	3,246	3,444	4,122
35-44. . . .	1,605	1,842	2,457	3,029	3,449	4,055	5,014	7,085
45-54. . . .	1,812	2,073	2,650	3,247	3,725	4,689	5,639	8,116
55-64. . . .	2,000	2,045	2,478	3,010	3,496	4,548	5,162	7,655
65 or more	1,140	1,189	1,560	1,898	2,379	3,155	3,435	5,421

Source: See nn. 6 and 7.

teen; four years of high school, age eighteen; one to three years of college, age twenty; and four years of college, age twenty-two. In fact, however, for age groups under fourteen the age-income profiles take values of zero, because no income data are collected for these groups.⁹

Two major cost variants are used in the calculations—one for total resource costs and the other for private resource costs. The rationale and procedures for

⁹ It is unfortunate that such data are not collected since the earnings of male workers below age fourteen are assuredly not zero. Thus opportunity costs are understated to some extent.

same three components except that in (1) above, tuition and fees paid by individuals are substituted for society's costs which are normally defrayed through taxation.

In developing the cost figures used in these estimates, whether on a total or a private resource basis, the opportunity costs were taken directly from the age-income profiles of the alternative level of schooling being used in the calculations. For example, at age eighteen the opportunity cost for the person undertaking four years of college is the income that

¹⁰ "Capital Formation by Education," *op. cit.*

the high-school graduate would obtain from ages eighteen to twenty-one. This procedure made it unnecessary to rely upon indirectly estimated opportunity cost figures and yielded at the same time a more detailed set of opportunity costs by age and level of schooling.¹¹ In completing the estimates of per student total resource cost, school costs paid by society and school-related expenditures incurred

costs, by age and grade are summarized in Table 2.

Lifetime cost-income streams were then constructed for each level of schooling with the help of the appropriate age-income profiles and the age-cost estimates. This was done by taking the difference between the cost-income profile for a given level of schooling and the income profile for the particular base

TABLE 2
AVERAGE ANNUAL PER STUDENT COSTS, EXCLUSIVE OF OPPORTUNITY COSTS,
BY AGE AND GRADE, UNITED STATES, 1949*

AGE	SCHOOL LEVEL (1)	TOTAL RESOURCE COSTS			PRIVATE RESOURCE COSTS		
		School Costs (2)	Other Costs (3)	Total (4)	Tuition and Fees (5)	Other Costs (6)	Total (7)
6-13.....	Elementary	\$201	.....	\$201	.....	.....	.....
14-17.....	High School	354	31	385	.....	31	31
18-21.....	College	801	142	943	245	142	387

* Though these cost data are indicated as being for 1950 in Schultz, "Capital Formation by Education," *op. cit.*, they actually apply to the 1949-50 school year. Thus these data may overstate somewhat the costs of schooling relative to the income derived from that schooling.

Source: col. (2), *elementary school*: Schultz, "Capital Formation by Education," *op. cit.*, Table 3, col. (11), 1950 figure divided by number of elementary-school students in 1950, from *Statistical Abstract*, 1955, Table 152; *high school*: Schultz, "Capital Formation by Education," *op. cit.*, Table 5, 1950, col. (4) divided by col. (1); *college*: *ibid.*, Table 6, 1950, col. (4) divided by col. (1).

Col. (3), *elementary school*: assumed to be zero; *high school*: *ibid.*, Table 5, 1950, col. (5) divided by col. (1); *college*: *ibid.*, Table 6, 1950, col. (4) divided by col. (1).

Col. (4), sum of cols. (2) and (3).

Col. (5), *elementary school* and *high school*: assumed to be zero; *college*: based on average tuition and fee charges, derived from *Biennial Survey of Education, 1955-56*, chaps. i and iv, after adjusting veteran charges for non-tuition items (see n. 13).

Col. (6), same as col. (3).

Col. (7), sum of cols. (5) and (6).

by individuals were derived from Schultz's results.¹² In completing the estimates of private resource costs, the amount of tuition and fees paid per student was obtained from already available estimates.¹³ Again, the school-related costs from Schultz's work were used. While the latter costs have an arbitrary quality to them, they seem to be reasonable.¹⁴ The cost figures, exclusive of opportunity

level of schooling used in the comparison. For example, in the case of investment in four years of college, the income profile

¹³ Average college tuition and fees amounted to \$245 in 1949 (see Ernest V. Hollis, "Trends in Tuition Charges and Fees," *Higher Education*, XII [June, 1956], 70). Actually, a figure of \$245 was used; this figure was estimated from data on tuition and fees collected, reported for 1949-50 in *Biennial Survey of Education, 1955-56* (Washington: Government Printing Office, 1957), chap. iv. See sources to Table 2.

¹⁴ Schultz simply assumed that these costs were 5 per cent of income foregone at the high-school level and 10 per cent of income foregone at the college level. The absolute figures derived from Schultz's work were used in these calculations even though the income foregone figures differed somewhat.

¹¹ These opportunity cost figures tend to be slightly lower, on a per student basis, than those of Schultz, which average \$583 for high school and \$1,369 for college, on an annual basis.

¹² *Ibid.*

for the base group, high-school graduates, begins at age eighteen. The cost-income profile for the person who completes four years of college also begins at age eighteen; during the four years to age twenty-one it reflects both school and school-related costs and thereafter the somewhat higher income profile of the college graduate. The cost-income stream, the *difference* between these two profiles, reflects at ages eighteen to twenty-one both school and school-related costs as well as opportunity costs; at ages beyond twenty-one the difference reflects the net income stream resulting from four years of college. An additional adjustment is required to reflect the incidence of mortality; this involves adjusting the net cost-income stream downward to reflect the probabilities that at each age the costs or returns will not be incurred or received, respectively.¹⁵ Finally, the internal rates of return must be estimated by finding that rate of discount which sets the present value of the cost stream equal to the present value of the net return stream.

When considering private rates of return, it is important to show them on both a before- and after-tax basis. Not only will all rates of return be lower after tax, but also the relative declines in the rates will differ, given the progressivity of tax rates and the positive association between income and educational levels. The differences among the before-tax and after-tax rates could be of considerable importance to individuals in the deter-

mination of their own investment planning.

To estimate the after-tax incomes and rates of return, the original income data in Table 1 were adjusted for federal income tax payments; while it probably would have been desirable to adjust for all types of taxes, this could not be done in view of the paucity of data. Subsequently, the rates of return were calculated in the same way as described for the before-tax data. The actual after-tax income figures were obtained by multiplying each income figure by the appropriate ratio of after- to before-tax income, derived from Houthakker.¹⁶ These ratios prove to be almost identical to those that would have resulted had the marginal tax rates been applied to the distributions of income recipients in calculating after-tax income.¹⁷

As in most empirical studies the available data prove to be somewhat unlike those that we require, and so the rate of return estimates do not provide a full picture of the profitability of schooling.¹⁸ Therefore, several features of the data and the nature of their effects on age-income profiles, and hence on rates of return, deserve mention before the results are discussed. First, since only in-

¹⁶ Houthakker, *op. cit.*, calculated from Tables 1 and 2, pp. 25-26.

¹⁷ Several of the education-age categories were adjusted for taxes by applying the average effective tax liability by size of income group to the midpoint of the size group to determine the mean tax paid. In general, the average effective tax rate derived for an education-age category was almost identical with that calculated by Houthakker.

Admittedly, the use of the average tax liability ignores the effects of age differences, family size, and so on, but it did not seem worthwhile to adjust for these factors, even to the limited extent that such adjustments could be attempted.

¹⁸ The main criticisms of this whole approach have been expressed most fully and forcefully by Edward F. Renshaw, "Estimating the Returns to Education," *Review of Economics and Statistics*, XLII (August, 1960), 318-24.

¹⁵ Calculated from United States Department of Health, Education, and Welfare, National Office of Vital Statistics, *United States Life Tables, 1949-51* (Special Reports, Vol. XLI, No. 1 [Washington, 1954]). No attempt was made, however, to adjust for the incidence of unemployment, largely because of the difficulty of disentangling unemployment from non-labor-force status in the data, which show all males classified by the receipt or non-receipt of income rather than by labor-force status.

come rather than earnings data are available, the income profiles used reflect in part receipts from other assets. On the assumption that the relative income from other assets is a positive function of the level of earnings itself, the impact of this would presumably be to raise the age-income profiles of the higher level of schooling groups. Second, certain problems of "mix" exist within the data. For example, among those with little schooling there may be heavy concentrations of certain minority groups, such as Negroes and Puerto Ricans. If they are effectively discriminated against, then the age-income profiles of the lower level of schooling groups would be depressed below their expected level. On the other hand, at higher levels of schooling the age-income profiles may be raised somewhat by reverse discrimination that favors sons, relatives, and others of higher social-economic status. Third, since those people who complete more schooling ordinarily possess greater intelligence, as measured by intelligence scores, some part of the differential income received might have accrued to them anyway. Although our present knowledge makes it difficult to separate the impact of intelligence and schooling, the observed income differences among the lower and higher levels of schooling undoubtedly overstate, and by increasing amounts, the differentials attributable to schooling.¹⁹ Fourth, all cost elements were considered as investment even though some portions might better be regarded as consumption. To the extent that any of the cost is considered as consumption, the investment costs are overstated.²⁰

¹⁹ Becker, *op. cit.*, has made some adjustments for differences in ability, but his method of doing so is not yet available. Differences in intelligence at different levels of schooling are given in Dael Wolfe, *America's Resources of Specialized Talent* (New York: Harper & Bros., 1954), pp. 142-49.

Fifth, all estimates rest on cross-section cost-income relationships and thereby ignore future shifts in the relationships of the cost-income streams. And finally, any number of other factors may impinge on the observed income differentials, in the form of education at home, on-the-job-training, and so forth.

While some would suggest that the presence of such problems seriously limits any conclusions concerning the empirical relationships between income and schooling, it nevertheless seems worthwhile to set forth the rate of return estimates in their crude form.²¹ From them some preliminary conclusions about resource allocation can be drawn.

II. INTERNAL RATE OF RETURN ESTIMATES

A. THE RETURN TO TOTAL RESOURCE INVESTMENT

Internal rates of return to total resource investment in schooling appear in Table 3. The boxed figures in the diagonal to the right show the rates of return to each successive increment of schooling and can be interpreted as "marginal" rates of return. For example, the rate of return to the first two years of elementary school is 8.9 per cent, to the next four years of elementary school 14.5 per cent, and so on to the last two years of college 15.6 per cent. Although the marginals provide all of the necessary information, average rates of return to successively more years of schooling can be derived from the marginals; since the average rates are of some interest, they are also shown in the columns. For example, in column (1) we see that at age six the ex-

²⁰ This point is discussed in T. W. Schultz, "Investment in Human Capital," *American Economic Review*, LI (March, 1961), 1-17.

²¹ For another dissenting note see John Vaizey, *The Economics of Education* (London: Faber & Faber, 1962), chap. iii.

pected rate of return to investment in two years of elementary schooling is 8.9 per cent; the rate of return to investment in six years of elementary schooling (the weighted average of the two marginals) is 12.0 per cent, and so on to the investment in sixteen years of schooling, which yields a 12.1 per cent rate of return.

Several features of the configuration of rates of return deserve comment. First, the marginal rates rise over the first few

a significant rise with the completion of four years of college. At this point one can only speculate as to the reasons underlying these declines.

Evidence such as this on the marginal or incremental rates of return is ordinarily used in discussing resource allocation. If on the basis of these rates of return a given amount of resources were to be spent on schooling, the ranking of the marginals from high to low is as follows:

TABLE 3
INTERNAL RATES OF RETURN TO TOTAL RESOURCE INVESTMENT IN SCHOOLING,
UNITED STATES, MALES, 1949*

To:	From:		(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Age	Grade	6 1	8 3	12 7	14 9	16 11	18 13	20 15
(1)	7	2	8.9	....	....	....	....	....	....
(2)	11	6	12.0	14.5	....	....	....	....	....
(3)	13	8	15.0	18.5	29.2	....	....	....	....
(4)	15	10	13.7	15.9	16.3	9.5	....	....	....
(5)	17	12	13.6	15.4	15.3	11.4	13.7	....	....
(6)	19	14	11.3	12.1	11.1	8.2	8.2	5.4	....
(7)	21	16	12.1	12.7	12.1	10.5	10.9	10.2	15.6

* All rate-of-return figures are subject to some error, since the estimation to one decimal place was made by interpolation between whole percentage figures.

years of schooling, reaching a peak with the completion of elementary schooling. This clearly suggests that rapidly increasing returns to schooling prevail over the early years and that a small initial amount of schooling, the first two years, has relatively little impact on earning power. Second, the trend in the rates is downward thereafter, though it is not smooth by any means. While the rate of return to the first two years of high school drops dramatically, it rises somewhat with the completion of high school. The rate drops once again for the first two years of college, and it then displays

Grades 7-8, 15-16, 3-6, 11-12, 9-10, 0-2, and 13-14.²² At an alternative rate of return to society of, say, 10 per cent, investment in all grade levels except the last three would be justified. Were the alternative rate, say, 7 per cent, only the last level would be excluded.

Viewing the matter in this fashion would be quite satisfactory if the rates of return declined steadily as we moved to successively higher increments of schooling, but because the marginal rates

²² It is interesting to note that most states require compulsory school attendance at least to age fourteen (in effect, to the end of Grade 8).

fluctuate some averaging is required. If we look at marginal rates for broader increments of schooling, for example, eight years of elementary school, four years of high school, and four years of college, then the rates of return to additional investment quite clearly decline, as shown by the respective figures: 15.0 per cent (col. [1], row [3]), 11.4 per cent (col. [4], row [5]), and 10.2 per cent (col. [6], row [7]). At an alternative rate of return of 10 per cent, investment in all levels of schooling becomes profitable. But were the original rates considered independently of each other and an alternative rate of return of 10 per cent prevailed, it would not pay to permit any new enrolments, the schooling of those people in elementary school would be terminated at Grade 8, and of those people already in high school and college, only students in their last two years of each would be allowed to graduate. To allocate investment in schooling this way would obviously reflect a very short-run view of the implied economic opportunities.

However, it might be desirable to consider some longer time horizon instead, particularly if the alternative rate of return were expected to remain reasonably constant over time. Given an alternative rate of return of, say, 10 per cent, investment through the completion of college could easily be justified for each age group currently enrolled, since every rate of return figure in the bottom row (row [7]) of Table 3 exceeds 10 per cent. Understandably, this result is no different than that obtained earlier.

On the basis of even longer-run considerations only the rate of return to investment in the schooling of new school entrants may be relevant, especially if schooling is thought of as a good to be purchased in large, indivisible quantities, for example, schooling from Grade 1

through college, or schooling from Grade 1 through high school. In this case the rates of return shown in column (1) indicate yields of 13.6 and 12.1 per cent, respectively, and suggest the obvious advantages of seeing to it that everyone completes college or high school, as the case may be. In fact, this averaging of the marginal rates makes such investment attractive at an alternative rate as high as 12 per cent.

B. THE RETURN TO PRIVATE RESOURCE INVESTMENT

Internal rates of return to total resource costs of schooling are of undeniable importance in assessing the efficiency with which an economy's resources are allocated, but for individuals and/or their parents the relevant rates of return are those based upon private resource costs. These private rates of return both before and after tax are shown in Tables 4 and 5, respectively; the tables are to be read in the same fashion as Table 3.

For all levels of schooling under eight years, private rates of return have no real meaning (they are infinitely large) since opportunity costs are assumed to be zero, school-related costs are negligible, and tuition and fees are not charged. Above Grade 8, however, all private rates of return before tax are higher than the total rates of return shown in Table 3, with the greatest disparities appearing at the younger ages and lower levels of schooling, where individuals pay smaller proportions of total resource costs; private rates of return after tax are also higher than total rates of return with but two exceptions. Otherwise, the general configuration in both the columns and the diagonals appears to be about the same for both total and private rates, whether before or after tax, though the levels do differ.

TABLE 4
INTERNAL RATES OF RETURN TO PRIVATE RESOURCE INVESTMENT IN SCHOOLING,
BEFORE TAX, UNITED STATES, MALES, 1949*

FROM:		(1)	(2)	(3)	(4)	(5)	(6)	(7)
To:	Age Grade	6 1	8 3	12 7	14 9	16 11	18 13	20 15
(1)	7 2	†	....	....	....	....	....	....
(2)	11 6	†	†	....	....	....	....	....
(3)	13 8	†	†	†	....	....	....	....
(4)	15 10	28.3	34.6	25.9	12.7	....	....	....
(5)	17 12	25.6	29.4	23.3	15.3	18.6	....	....
(6)	19 14	18.1	18.7	14.8	10.4	9.5	6.2	....
(7)	21 16	18.2	18.7	16.2	12.9	13.0	11.6	18.7

* All rate-of-return figures are subject to some error, since the estimation to one decimal place had to be made by interpolation between whole percentage figures.

† This indicates an infinite rate-of-return, given the assumption that education is costless to the individual to the completion of eighth grade.

TABLE 5
INTERNAL RATES OF RETURN TO PRIVATE RESOURCE INVESTMENT IN SCHOOLING
AFTER TAX, UNITED STATES, MALES, 1949*

FROM:		(1)	(2)	(3)	(4)	(5)	(6)	(7)
To:	Age Grade	6 1	8 3	12 7	14 9	16 11	18 13	20 15
(1)	7 2	†	....	....	....	....	....	....
(2)	11 6	†	†	....	....	....	....	....
(3)	13 8	†	†	†	....	....	....	....
(4)	15 10	27.9	33.0	24.8	12.3	....	....	....
(5)	17 12	25.2	28.2	22.2	14.5	17.5	....	....
(6)	19 14	17.2	17.5	13.7	9.4	8.5	5.1	....
(7)	21 16	17.2	17.3	14.4	11.5	11.4	10.1	16.7

* All rate-of-return figures are subject to some error, since the estimation to one decimal place had to be made by interpolation between whole percentage figures.

† This indicates an infinite rate of return, given the assumption of costless education to the individual through the completion of eighth grade.

When individuals and/or their parents plan an investment program in schooling, the private rates of return justify securing more schooling than do the rates of return on total resource investment. For example, the marginal rates of return to elementary, high-school, and college schooling are infinite (col. [1], row [3]), 15.3 per cent (col. [4], row [5]), and 11.6 per cent (col. [6], row [7]), respectively. Thus, investment in schooling through college is still profitable even if the private alternative rate is as high as 11.5 per cent. But, on an after-tax basis, the alternative rate of 10 per cent just permits private investment at the college level (Table 5, col. [6], row [7]).

When schooling is viewed in large blocks, a somewhat different picture emerges. If the decision-making age is fourteen and the objective is to complete schooling through college, the alternative rate of return would have to exceed 12.9 per cent (col. [4], row [7]) on a before-tax basis and 11.5 per cent on an after-tax basis for the investment to be unprofitable. If the decision-making age is six and the objective is to complete schooling through college, the alternative rate would have to exceed 18.2 per cent (col. [1], row [7]) on a before-tax basis and 17.2 per cent on an after-tax basis, for the investment to be unprofitable.

A comparison of the total rates of return with the private rates of return after tax is of interest in suggesting the extent to which distortions in the private rates caused by federal income taxes are offset by the counter-distortion of subsidized schooling. An examination of the results in Tables 3 and 5 indicates that even though income taxes do substantially reduce the levels of private rates of return, public subsidization of schooling makes the private rates of return net of tax considerably more attractive than

the rate of return earned on total resource investment. Only two exceptions appear (col. [6]); these suggest that the student pays more than his own way in securing schooling at the college level. This might indicate the need for a re-study of the assessment of the costs of college against the individual, unless the possible underinvestment in college training that would be produced is regarded as acceptable in some broader sense. But these exceptions aside, the fact that private rates of return after taxes exceed the total rates of return would, in the absence of restraints on sources of private financing, probably give rise to overinvestment in schooling by individuals. However, a fuller treatment of the effects of other forms of taxation and methods of financing schooling would be required before any definitive judgment could be reached.

III. ALTERNATIVE MEASURES OF PRIVATE ECONOMIC RETURNS FROM SCHOOLING

The economic returns to individuals from schooling can be observed from three different points of view: (1) the value of lifetime income as set forth by Miller,²³ (2) the present value of lifetime income as set forth by Houthakker,²⁴ and (3) the rate of return on investment in schooling as set forth here. While the lifetime income and present value of lifetime income methods, particularly the former, are rather widely used, they are not relevant to ranking the direct economic returns to schooling when schooling is treated as a type of investment expenditure. Both of these methods completely ignore the costs of schooling, while the lifetime income approach suffers from the further defect of ignoring the time shape of the returns. Because the rankings of the economic returns differ so substan-

²³ *Op. cit.*

²⁴ *Op. cit.*

tially, it seems desirable to present all three measures of the returns and to discuss them briefly. To make the comparisons more manageable, we shall deal only with the additional returns to different amounts of schooling as seen at age fourteen. The before- and after-tax results appear in the upper and lower halves, respectively, of Table 6.

consideration,²⁶ the full extent to which these returns offset the costs of schooling is not at all clear. Even more important, the fact that the time flows of these returns also differ remains hidden in the calculation of the lifetime income values. By virtue of these omissions, the impression emerges that any and all amounts of schooling are worth obtaining.

TABLE 6

ALTERNATIVE METHODS OF COMPARING VALUE OF PRIVATE ECONOMIC RETURNS TO INVESTMENT IN SCHOOLING, AS VIEWED AT AGE FOURTEEN, UNITED STATES, MALES, 1949

SCHOOLING FROM COM- PLETION OF GRADE 8 TO COMPLETION OF	ADDITIONAL LIFETIME INCOME (1)	PRESENT VALUE OF ADDITIONAL INCOME AT				INTERNAL RATE OF RETURN (PER CENT) (6)
		3 Per Cent (2)	6 Per Cent (3)	8 Per Cent (4)	10 Per Cent (5)	
2 years high school. 4 years high school. 2 years college. 4 years college. 2 years high school. 4 years high school. 2 years college. 4 years college.	Before Tax					
	\$ 16,802	\$ 7,756	\$ 2,301	\$1,190	\$ 545	12.7
	46,038	18,156	6,488	3,601	1,949	15.3
	66,763	23,800	7,352	3,215	996	10.4
	141,468	49,429	17,252	8,722	4,135	12.9
	After Tax					
	\$ 14,143	\$ 5,081	\$ 1,956	\$ 996	\$ 436	12.3
	38,287	13,580	5,362	2,929	1,547	14.5
	52,485	17,000	5,364	2,084	336	9.4
	109,993	36,575	12,824	6,170	2,611	11.5

The value of additional lifetime income associated with higher levels of schooling is frequently cited as a justification for investment in schooling by the individual. Clearly, the values of additional lifetime income resulting from successively greater amounts of schooling (col. [1]), indicate that more schooling pays substantially larger dollar returns than less schooling.²⁵ But, since a portion of the costs of schooling is excluded from

Another method of measuring the economic returns to schooling involves comparing the present values of additional lifetime income, at various discount rates, to successively greater amounts of schooling. The values, at discount rates of 3, 6, 8, and 10 per cent appear in col-

²⁵ The differences shown here differ somewhat from those that are derived from Miller and Houthakker because of differences in the assumed shapes and levels of the age-income profiles.

²⁶ Opportunity costs are reflected in the figures showing "additional" lifetime income inasmuch as the income of the person in school is set at zero while his income-earning counterpart receives a positive income; the difference appears in the cost-return stream and measures opportunity costs. However, the other private costs of schooling are omitted in this calculation.

umns (2), (3), (4), and (5), respectively.²⁷ Again, schooling pays at any or all of the discount rates used, though the rankings do shift about as the discount rate is varied. For example, at 3 and 6 per cent the rankings coincide with those shown by the value of additional lifetime income, but at an 8 per cent discount rate schooling to the first two years of college becomes absolutely less attractive financially than schooling to high school, whether before or after tax. And at a 10 per cent discount rate the after-tax return to schooling to the first two years of college falls below that to the first two years of high school. Even though the present-value figures are quite sensitive to the discount rate used, once again all schooling pays. But the basic flaw in this method of calculation is the omission of some of the costs of education from the calculation; specifically, the method fails to subtract the present value of the non-opportunity costs from the present value of the additional income. Doing so would undoubtedly cause some additional changes in the rankings, particularly at the higher discount rates.

Finally, the rate-of-return approach remedies the defects inherent in the other two methods. The relevant data on internal rates of return from Tables 4 and 5 (see Table 6, col. [6]), reveal a much different ranking of the returns to schooling. On a before-tax basis, investment in schooling to completion of high school, with a 15.3 rate of return, yields by far the most attractive return, followed by schooling to college with 12.9 per cent, and schooling to the first two years of high school with 12.7 per cent; schooling

to the first two years of college, with a 10.4 per cent return, lags far behind.

When we shift to rates of return on an after-tax basis, the rankings of the return on schooling to the completion of college and to the completion of the first two years of high school change. Since the marginal tax rates are a function of the amount of the income differential, the effect of the tax on the college rate of return is decidedly greater than its effect on the rate of return to the first two years of high school, for example. Given the fact that the original rates of return were almost identical, the after-tax return to completion of college now drops considerably below that to completion of two years of high school.

In conclusion, it appears that ranking of the returns to investment in schooling by the rate-of-return method is clearly superior to the methods employed in the work of both Miller and Houthakker. Whether the more general rate-of-return rule is in fact superior to the present-value rule (when properly used) still remains an unsettled issue that will not be discussed here.²⁸

IV. CONCLUSION

Estimates of the internal money rates of return to both total and private resource investment in schooling have been presented to provide a more complete picture of the costs of and returns to schooling. While the rates of return to private resource investment obviously exceed those to total resource investment, we find that the rates of return to the various increments of schooling also differ and have somewhat different implications for resource allocation at both

²⁷ The differences shown here differ somewhat from those derived from Houthakker because of differences in the assumed shapes and levels of the age-income profiles.

²⁸ For a fuller treatment of this point see J. Hirshleifer, "On the Theory of Optimal Investment Decision," *Journal of Political Economy*, LXVI (August, 1958), 329-52.

the societal and individual level. Basically, the marginal rates of return rise with more schooling up to the completion of Grade 8 and then gradually fall off to the completion of college. We also find that private rates of return after tax almost invariably exceed the total rates of return, a situation that could presumably induce private overinvestment in schooling. Finally, the rate of return provides a superior method of ranking the economic returns to investment in schooling than do the more conventional additional lifetime income or present value of additional lifetime income methods currently used.

Thus, one might conclude that the high rates of return to investment in schooling go a long way toward explaining, or justifying, this society's traditional faith in education, as well as the desire of individuals to take advantage of as much schooling as they can. But clearly we need to know much more about the relationship between income and ability,

the importance of on-the-job training, the significance of education in the home, and so forth. My own suspicion is that full adjustment for these factors would have the effect of reducing the relative rates of return, especially at the higher levels of schooling.

In addition, we have barely begun to consider the possible disparity between the rate of return to total resource investment and the "social" rate of return to investment in schooling that takes additional account of those returns that are produced indirectly. Intuition as well as the little evidence available suggests that these returns may be considerable, but a full accounting of the economic value of schooling will have to await further work.²⁹

²⁹ For an excellent analysis of some of the conceptual differences between private and social returns see Mary Jean Bowman, "Social Returns to Education," *International Social Sciences Review* (forthcoming), and Burton Weisbrod, "Education and Investment in Human Capital," *Journal of Political Economy: Supplement*, LXX (October, 1962), 106-23.