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APPENDIX A

Sources and Methods

THIS appendix sets out some of the sources and methods used in deriving the rates of return and other figures presented in the study. It should be read by all persons planning to use the findings since the basic data are quite imperfect and many adjustments could have been made differently. First, the methods used to estimate incomes at different levels of education are presented and then those used to estimate costs.

1. Incomes

A. THE BASIC DATA

The basic income data came from the 1940 and 1950 Censuses and from the surveys of 1956 and 1958.[1] M. Zeman estimated mean earnings by age and education in 1939 from data in the 1940 Census which gave the distribution of persons by income class.[2] I used the 1950 Census to make my own estimates of incomes in 1949, and H. Miller estimated means from the 1956 and 1958 surveys.[3] Zeman used

1 See *Sixteenth Census of the United States: 1940, Population, Education, Educational Attainment by Economic Characteristics and Marital Status,* Bureau of the Census, Washington, 1947, Tables 29 and 31. *United States Census of Population, 1950,* Special Reports, *Education,* Vol. IV, part 5, Chapter B, Bureau of the Census, Washington, 1953, Table 12. *Income of Families and Persons in the United States* for 1956 and 1958, Current Population Reports, Consumer Income, Bureau of the Census, Series P-60, nos. 27 and 33, Washington, 1958 and 1960.

2 See his "A Quantitative Analysis of White-Non-White Income Differentials in the United States in 1939," unpublished Ph.D. dissertation, University of Chicago, 1955, Tables 13 and 16.

3 See his "Annual and Lifetime Income in Relation to Education, 1939-1959," *American Economic Review,* December 1960, Table 1.

incomes near the midpoints of all closed income classes as the means of these classes, and Lorenz distributions to estimate the means of the $5,000-and-over class. Miller used the midpoints of all closed classes and the single figure $20,000 as the mean of the $10,000-and-over class. I used essentially the midpoints of all closed classes and Pareto distributions to estimate means in the open-end class, except that the maximum mean in the open-end class was limited to $27,000, the minimum to $15,000, and obviously incorrect figures were eliminated. The same means were used for elementary-school graduates as for high-school graduates.[4] These estimates are shown in Table A-1.

TABLE A-1

OPEN-END MEANS USED IN CALCULATING 1949 INCOMES
(dollars)

	Years of Education			
Age	8	12	13-15	16+
14-15	15,000	--	--	--
16-17	15,000	--	--	--
18-19	15,000	15,000	--	--
20-21	15,000	15,000	15,000	--
22-24	15,000	15,000	15,000	16,826
25-29	15,213	15,213	15,068	17,157
30-34	15,782	15,782	15,915	16,926
35-44	17,971	17,971	19,231	22,349
45-54	22,739	22,739	25,446	27,000
55-64	26,656	26,656	27,000	27,000

Source: See text.

My estimates for 1949 differ from those of Houthakker and Miller[5] primarily because of the different treatment of the open-end class. They use the same open-end mean at all age and educational levels, Miller $20,000 and Houthakker $22,000, while mine rises significantly with age and education. There is little question that actual open-end means do rise with age and education, so that they overestimate incomes at lower levels relative to those at higher ones. Table A-2 indicates, however, that at most ages all three studies show similar income differentials between education classes. Zeman and Miller exclude persons with no income although they should be included in estimat-

4 So few elementary-school graduates are in the open-end class that estimates based on Pareto distributions were unstable. Moreover, because so few are in this class, it does not greatly matter which means are used.

5 *Ibid.* and H. S. Houthakker, "Education and Income," *Review of Economics and Statistics,* February 1959, pp. 24-28.

ing cohort incomes for exactly the same reason that dead members of a cohort are included (via mortality adjustments).

I have assumed that persons attend college only from ages 18 to 22½ and high school only 14 to 17. Actually, of course, high school and college are also attended at earlier and, especially after World War II, later ages. Moreover, the Census only tries to ascertain the highest grade completed and excludes partial years of schooling.

TABLE A-2

THREE ESTIMATES OF BEFORE-TAX INCOME DIFFERENTIALS BETWEEN EDUCATION CLASSES IN 1949 (dollars)

	INCOME DIFFERENCES BETWEEN PERSONS WITH:					
	12 and 8 Years of School			16+ and 12 Years of School		
Age	Houthakker	Miller	Becker[a]	Houthakker	Miller	Becker[a]
22-24	417		413	-522		-378
25-29	642	706	638	201	876	228
30-34	819		810	1,577		1,439
35-44	1,023	1,026	993	3,135	3,030	3,416
45-54	1,438	1,442	1,551	3,631	3,427	4,753
55-64	1,504	1,538	1,890	3,280	3,107	4,051

Source: Houthakker, Review of Economics and Statistics, February 1959, Table 1, p. 25; and Miller, American Economic Review, December 1960, Table 1, p. 966.

[a]Whites only.

Together, these facts imply that some persons over age 22½ with 16+ years of schooling would still be in school and, therefore, at best working only part time; similarly, for high-school graduates over age 18 and those with 13-15 years of school over age 20. Consequently, reported incomes at certain ages would not completely measure full-time incomes; data on the fraction of persons reporting no income, shown in Table A-3, suggest that in 1949 the bias is significant for 16+ years of schooling at ages 22-29, for 13-15 years at ages 20-24, for 12 years at ages 18-21, for 9-11 years at ages 16-19, and for 8 years at ages 14-17, while of lesser significance at other ages. Therefore, all persons with zero income have been included at these other ages, while only 2 per cent of persons who have 16+ school years aged 22-29, 13-15 years aged 20-24, and 12 years aged 18-21 are assumed to have no income (persons aged 14-19 with 8 and 9-11 years of schooling are discussed later).

B. UNDER- AND OVERREPORTING

From a comparison of Census and national income data, S. Goldsmith concluded that the Census underreports all types of income, the bias being greatest for dividends, interest, and other kinds of property income, and least for wages and salaries.[6] Her study suggests that wages and salaries were underreported by about 10 per cent. The 1940 data cover only wages and salaries, so they were simply uniformly

TABLE A-3

FRACTION OF WHITE MALES REPORTING NO INCOME IN 1949 BY AGE AND EDUCATION CLASS

	Years of Education				
Age	8 (1)	9-11 (2)	12 (3)	13-15 (4)	16+ (5)
14-15	.778	--	--	--	--
16-17	.569	.595	--	--	--
18-19	.227	.333	.239	--	--
20-21	.129	.108	.102	.240	--
22-24	.065	.046	.052	.116	.123
25-29	.043	.030	.026	.046	.045
30-34	.035	.024	.020	.019	.022
35-44	.033	.025	.023	.020	.020
45-54	.041	.036	.035	.029	.025
55-64	.065	.060	.059	.046	.041

Source: 1950 Census of Population, Education, Vol. II, Table 12.

increased by 10 per cent to correct for the apparent Census bias. Since the understatement is probably greater at higher earning levels, the adjustment is probably too large at lower age-education classes and too small at upper classes.

To increase comparability with the 1940 Census, property incomes in the 1950 Census and the two Census surveys should be excluded. Since Table A-4 indicates, however, that aggregate earnings are about equal to the total incomes reported by the Census, the underreporting of earnings just about offsets the inclusion of property and other "unearned" income. Therefore, at the aggregate level at least, Census incomes can be used to measure true earnings. Although property income would be a larger percentage of total incomes at higher age-education levels, as noted above, the underreporting of earnings

[6] See Selma Goldsmith, "The Relation of Census Income Distribution Statistics to Other Income Data," *An Appraisal of the 1950 Census Income Data*, Studies in Income and Wealth 23, Princeton for NBER, 1958.

TABLE A-4

COMPARISON OF INCOMES REPORTED BY CENSUS AND COMMERCE FOR 1946 AND 1954 (dollars)

Source and Type of Information	1946	1954
Total earnings		
OBE series, adjusted	135.1	218.8
Total income		
CPS	129.8	217.7

Source: S. Goldsmith, in Appraisal of 1950 Census Income Data, Table 2.

probably also rises with age and education. Hence the unadjusted data may not greatly overestimate earning differentials between different levels.

C. UNEMPLOYMENT

Earnings of less-educated persons are usually more affected by business cycles, partly because their employment is more volatile and partly because wages fluctuate more than salaries. Incomes reported in Census and other surveys refer to particular stages of business cycles, while rates of return depend on lifetime earnings accruing over several full cycles. The 1950 Census and the 1956 and 1958 surveys cover relatively normal times and are probably only slightly affected, but the 1940 Census covers a period of sizable unemployment and might be seriously biased. Accordingly, I have tried to correct the 1940 Census data for their departure from "normality."

First, the average unemployment rate of wage and salary workers was estimated for each educational level in 1940, and the average duration of unemployment of all persons unemployed less than a year was computed.[7] If the average duration did not depend on education and if unemployed persons earned the same when employed as others, one could estimate what earnings would have been if nobody were unemployed.[8] Column 3 of Table A-5 presents these estimates which show that unemployment did increase percentage earning differentials between educational levels.

[7] Persons unemployed more than a year presumably do not have any wages or salaries and, therefore, are already excluded from Zeman's figures.

[8] Actually only abnormal unemployment should be eliminated as unemployment is normally also higher among less-educated persons. Only a small bias results, however, because normal unemployment was a small part of the total in 1939.

TABLE A-5

ADJUSTMENT FOR UNEMPLOYMENT IN 1939 BY EDUCATION CLASS

Education (years)	Per Cent Unemployed (wage and salary workers) (1)	Duration of Unemployment (years) (2)	Employment Adjustment (3)	Earnings Adjustment (4)
7-8	20.37	.63	1.08	1.08
12	14.10	.63	1.06	1.08
13-15	10.54	.63	1.04	1.07
16+	5.92	.63	1.02	1.07

Source

Col. 1: 1940 Census of Population, Education, Table 17, p. 76.
Col. 2: Computed from 1940 Census of Population, The Labor Force (Sample Statistics), Occupational Characteristics, Washington, 1943, Table 17, pp. 199 and 202.
Col. 4: Based on figures in ibid., Tables 3 and 6; and Employment, Payroll, Hours and Earnings, Bureau of Labor Statistics, L.S. 53-2884 and L.S. 53-0902.

Deviations of actual wages and actual salaries in 1939 from "normal" levels were determined by assuming that normal levels in 1939 equaled a simple average of actual levels from 1937 to 1941. Wage earners were separated from salary earners at each educational level with the help of Census information. If actual wages and salaries deviated from normal values by the same percentage at each educational level, normal wages and salaries in 1939 could then be easily determined. Ratios of normal to actual values are shown in column 4.

The coefficients in columns 3 and 4 were applied uniformly to all age classes, even though the incidence, at least of unemployment, is greater at younger ages. Although earnings of less-educated persons were raised by relatively large percentages, they were not raised by relatively large absolute amounts because the level of earnings is positively related to education. Accordingly, the adjustments for the depressed conditions of 1939 had a surprisingly small effect on rates of return.

D. COVERAGE IN 1939

The 1940 Census only reports the incomes of native whites with less than $50 of income other than wages and salaries. About one-third of all whites and more than half of the college graduates are omitted. The latter are especially underrepresented because independent professionals are excluded and most of them are college graduates. To rectify this underrepresentation, I estimated separately the earnings

and number at different ages of independent dentists, lawyers, and physicians.

Table A-6 presents these estimates along with the earnings and number of college graduates computed from the Census. The relative number and earnings of independent professionals rise strongly with age. Column 5 presents estimates of the average earnings of both groups combined, which are weighted averages of the earnings of each, the weights being their relative numbers. A comparison of columns 3 and 5 shows that the combined average is not very different from the Census average before age class 45-54. Since rates of return are dominated by earnings at younger ages, the omission of independent professionals would have little effect on these rates: it would lower the rate to college graduates by less than 1 percentage point.

Although the inclusion of independent professionals increases the coverage of college graduates to about the same levels as other education classes, considerable biases might result since more than one-third of all whites are still excluded. The biases offset each other to some extent, however, because presumably foreign-born persons earn less than natives and natives with property income earn more than other natives. Probably the net effect is to lower rates of return from high-school and college education since the relative importance of the foreign born is smaller at higher educational levels. Fortunately, as Table A-7 suggests, the biases are probably not very large because

TABLE A-6

AVERAGE EARNINGS OF CENSUS COLLEGE GRADUATES AND INDEPENDENT DOCTORS, DENTISTS, AND LAWYERS IN 1939

	Independent Professionals		Census College Graduates		
Age	Earnings (dollars) (1)	Number (2)	Earnings (adjusted for unemployment) (dollars) (3)	Number (4)	Earnings of Both Groups Combined (dollars) (5)
25-29	2,174	15,631	1,997	177,400	2,011
30-34	3,285	38,762	2,878	161,800	2,957
35-44	4,491	108,476	3,782	187,060	4,042
45-54	5,028	72,278	4,185	97,920	4,543
55-64	4,238	45,690	3,782	42,120	4,019

Source: Cols. 1 and 2 computed from William Weinfeld, "Income of Physicians 1929-49," Survey of Current Business, July 1951, Tables 1 and 16; "Income of Lawyers, 1929-49," Survey of Current Business, August 1949, Tables 1 and 10; and "Income of Dentists 1929-48," Survey of Current Business, January 1950, Tables 2 and 9; cols. 3 and 4 from 1940 Census of Population, Education.

the relative number of persons excluded is much smaller at younger ages for all education classes.

E. TAXES

Census and other surveys report before-tax incomes whereas incomes net of direct personal taxes are needed to estimate private rates of return. Internal revenue data were used in 1949 to find the average fraction paid in taxes at each income class, including the open-end class.[9] Means of after-tax incomes at all age-education levels were

TABLE A-7

FRACTION OF NATIVE WHITES AND URBAN WHITES INCLUDED IN 1939 DATA, BY AGE AND EDUCATION

	Ratio of Native Whites Included and Independent Professionals to All Native Whites, by Years of Education				Ratio of Urban White Males Included[a] to All Urban White Males, by Years of Education			
Age	7-8 (1)	12 (2)	13-15 (3)	16+ (4)	7-8 (5)	12 (6)	13-15 (7)	16+ (8)
18-19	.964	.758	.490	.582	—	—	—	—
20-21	.826	.850	.636	.589	.705	.740	.479	.495
22-24	.840	.863	.757	.696				
25-29	.843	.841	.795	.754	.728	.773	.724	.675
30-34	.822	.798	.745	.785	.671	.720	.675	.717
35-44	.776	.718	.651	.836	.589	.606	.570	.718
45-54	.704	.621	.553	.742	.488	.491	.480	.612
55-64	.604	.521	.443	.698	.386	.395	.369	.549

Source: Numerators are from Table A-6 and sources cited there; denominators of cols. 1, 2, and 4 are from 1940 Census of Population, Education, Table 29, pp. 14 f; denominators of cols. 5, 6, 7, and 8 are from 1940 Census of Population, Vol. IV: Characteristics by Age, Part 1 (U.S. Summary), Washington, 1943, Table 18, pp. 78 and 81.

[a]Also includes rural independent professionals aged 25 and over.

estimated from the after-tax incomes in each income class. Although there was little change in tax schedules between 1949 and 1956-58, the fraction of income paid in taxes increased from 7.5 to over 10 per cent between 1949 and 1956 because of the growth in money incomes. At each age-education class the fraction of income taxed in 1956 and 1958 was assumed to equal the fraction taxed in 1949 multiplied by the ratio of the aggregate tax rates. A more sophisticated adjustment would not have much effect on the results.

[9] See *Statistics of Income for 1949,* Part I, Washington, 1954, Table 8. The separate returns for women were excluded.

Only about 1.5 per cent of income was paid in direct personal taxes in 1939.[10] Urban males with seven or more years of schooling presumably paid a somewhat larger fraction: native whites perhaps about 4 per cent and nonwhites about 2 per cent. As mentioned in Chapter IV, 1939 cohorts receive the bulk of their incomes not in 1939 but in the 1940's, 1950's, and 1960's, and would be subject to the higher rates prevailing then. The after-tax incomes of 1939 cohorts were also estimated assuming that they paid the same fraction in taxes at each age-education level as 1949 cohorts did.

F. URBAN-RURAL DISTRIBUTION

The 1940 Census covers all urban persons while the other surveys cover rural persons as well. If elementary, high-school, and college graduates were differently distributed by place of residence, the rates of return could be biased since money incomes are related to size of place of residence. Table A-8 indicates that they had about the same distribution among urban areas; more educated persons, however,

TABLE A-8

DISTRIBUTION OF PERSONS OF DIFFERENT EDUCATIONAL LEVELS BY SIZE OF PLACE OF RESIDENCE, 1939

Years of Education	Urban Population (per cent)			Urban as Per Cent of Total
	Over 250,000 (1)	25,000-250,000 (2)	2,500-25,000 (3)	(4)
7-8	40.6	29.6	29.8	50.1
12	37.3	32.5	30.2	66.9
16+	39.1	30.9	30.1	76.4

Source: Cols. 1-3 from Table 17; col. 4 from 1940 Census of Population, Education, Table 29, pp. 147-151.

were less likely to live in rural areas. Consequently, the rates would have an upward bias in 1949 and later years because rural incomes are lower than urban ones even when education is held constant. The bias is small, however, because relatively few persons between the crucial ages of 18 and 45 are in nonurban areas.

[10] Taxes paid were found in *Statistics of Income for 1939*, Part I, Washington, 1942; adjusted gross income was estimated by C. H. Kahn, *Business and Professional Income Under the Personal Income Tax*, Princeton for NBER, 1964, Chapter 5.

G. HOURS OF WORK

Hours of work may differ among education classes for a variety of reasons: some persons retire earlier, have the opportunity to work more hours during any week, take longer vacations, and so on. Perhaps rates of return should be estimated from earnings per hour rather than the annual earnings presented in the Census and other reports. Fortunately, this difficult question does not have to be answered since average weekly hours of work apparently do not vary greatly among education classes. Table A-9 presents estimates from the 1940 Census based on the assumption that within occupations average hours of work did not vary systematically by education. In a recently published study, Finegan also finds no significant relation between hours of work and education.[11]

TABLE A-9

AVERAGE HOURS WORKED IN 1939, BY EDUCATIONAL LEVEL

Years of Education	Average Hours Worked
9-11	44.0
12	44.5
13-15	45.1
16+	44.7

Source: 1940 Census of Population, Labor Force (Sample Statistics), Occupational Characteristics, Table 3 (all employed persons) and Table 9 (wage and salary workers only).

2. *Costs*

A. EARNINGS OF STUDENTS

Earnings of students cannot be estimated directly from the Census reports since these do not separate student earnings from those of full-time participants in the labor force with the same number of completed school years. If "full-time" students spend three-quarters of the available working time at school and, therefore, have one-quarter (summers) available for employment, the simplest assumption is that they could earn about one-quarter of what they would earn if they were not attending school. That this is a surprisingly good assumption is brought out by Table A-10, which presents three largely

[11] A. Finegan, "A Cross-Sectional Analysis of Hours of Work," *Journal of Political Economy*, October 1962. He does find a relation when income is held constant.

independent estimates of the earnings of college students. The first simply assumes that they earn one-quarter of the earnings of high-school graduates aged 18-21; the second comes from a study giving the earnings of a sample of college students during the academic year 1952-53; the third is based partly on this sample and largely on the actual labor force participation of nonstudents and students between age 18 and 24. The last estimate indicates that college students work about one-quarter as much as nonstudents of the same age, while a comparison of the first and second estimates suggests that they earn about one-quarter as much as high-school graduates of the same age.[12]

TABLE A-10

ALTERNATIVE ESTIMATES OF FRACTION OF EARNINGS OF HIGH-SCHOOL GRADUATES OF SAME AGE RECEIVED BY COLLEGE STUDENTS

Source of Estimate	Fraction
Becker	.250
Costs of attending college	.349
Labor force participation	.236

Source: The denominator of the second estimate is my estimate of the average earnings of high-school graduates aged 18-21 in 1949; the numerator is determined from Costs of Attending College, Table 8, p. 48. The third estimate is largely derived from "The Employment of Students, October 1960," in Monthly Labor Review, July 1961, Tables C and E. Since the labor force participation surveys were taken in October, they tend to understate the relative participation of college students because they participate more during the summer. I have assumed that the relative participation of college students during the summer is the same as their relative earnings during the summer (derived from Costs of Attending College, Table 8), while the participation of nonstudents is the same throughout the year. The over-all participation rate of college students relative to nonstudents aged 18-24 could then be estimated from the formula

$$p = \frac{3}{4}s + \frac{1}{4}(3r)s,$$

where p is their over-all relative participation, s is their relative participation during the nonsummer months, and $3r$ is the participation of college students during the summer relative to the rest of the year. According to the sources cited, $3r = 1.413$ and $s = .214$; therefore $p = .236$.

[12] The ratio is somewhat higher in the second estimate because the earnings of students (in the numerator) are based on the academic year 1952-53, while the earnings of high-school graduates (in the denominator) are based on 1949. An adjustment for the strong general rise in earnings between 1949 and 1952-53 would lower the ratio to about .29. The difference between .25 and .29 is probably explained by the fact that the average age of college students is somewhat greater than 20, and their average ability is greater than that of high-school graduates. The .25 estimate, in effect, adjusts costs for the differential ability of college students, while the .29 estimate does not.

Consequently, the assumption that college students earn about one-quarter of the amount earned by high-school graduates of the same age is apparently fairly accurate, probably more so than some subtler assumptions that have been used.[13]

The 1940 Census and the 1956 and 1958 surveys do not give the earnings of persons younger than 18, so I simply assumed that the average earnings of elementary-school graduates increase from ages 14 to 18 at the same rate as from ages 18 to 21. The 1950 Census does give the incomes of persons aged 14-17 classified by education level. Column 1 of Table A-11 presents the mean incomes at ages 14-15 and 16-17 of all persons who have completed eight years of schooling, while column 2 presents much higher estimates obtained by extrapolating the rate of increase between ages 18-19 and 20-21. Since the

TABLE A-11

ALTERNATIVE ESTIMATES OF EARNINGS OF PERSONS AGED 14-17 WITH EIGHT YEARS OF SCHOOLING, 1949
(dollars)

Age	Including All Persons with Zero Incomes (1)	Extrapolated from Earnings at Age 18-19 and 20-21 (2)	Assuming Only 5 Per Cent Have Zero Incomes (3)
14-15	104	333	431
16-17	258	525	558

Source: 1950 Census of Population, Education, Table 12.

Census usually understates incomes immediately following the typical age of entrance into the labor force (see the earlier discussion in section 1a), most of those with zero incomes among college persons aged 20-29 and high-school persons aged 16-21 were omitted. Column 3 of Table A-11 gives the average incomes of elementary-school graduates

[13] Schultz' estimate of the earnings foregone by college students in 1950 is a good deal larger than that implicit in ours (see his "Capital Formation by Education," *Journal of Political Economy*, December 1960, Tables 1 and 2), partly because he uses the actual age distribution of college students and partly because he assumes (wrongly, I believe) that they forego forty weeks of income. (I am indebted to Schultz for very helpful discussions and correspondence on alternative estimating methods.) Blitz' estimates are even higher than Schultz' (see Rudolph C. Blitz, "A Calculation of Income Foregone by Students: Supplement to 'The Nation's Educational Outlay,'" in *Economics of Higher Education*, Selma J. Mushkin, ed., Washington, 1962, Appendix B, pp. 390-403). Albert Fishlow is currently making very detailed estimates of opportunity costs.

at ages 14-17 when zero incomes are assumed to be only 5 per cent of the total. These figures are actually higher than those based on extrapolation because about 78 per cent of 14- to 15-year-olds and 57 per cent of 16- to 17-year-olds with eight years of schooling reported no income in 1949. Yet less than 7 per cent of the elementary-school graduates over age 22 reported no income.[14]

The earnings of high-school students were assumed to equal one-quarter the estimated earnings of elementary-school graduates aged 14-17. Another estimate is presented in Table A-12 that is derived largely from surveys of labor force participation by students and nonstudents aged 14-17. This estimate indicates somewhat smaller actual, though larger foregone, earnings than ours does.[15]

TABLE A-12

ALTERNATIVE ESTIMATES OF FRACTION OF EARNINGS OF ELEMENTARY-SCHOOL GRADUATES OF THE SAME AGE RECEIVED BY HIGH-SCHOOL STUDENTS

Source of Estimate	Fraction
Becker	.25
Labor force participation	.21

Source: The second estimate was obtained in the same way as the third estimate in Table A-10. The sources are Employment of Students, Current Population Reports, Labor Force, October 1955 (Series P-50, No. 64), Tables 1 and C; and Special Labor Force Report No. 16, "The Employment of Students, October 1960," Monthly Labor Review, July 1961, Tables C and E. I had to assume that the relative summer participation of high-school students was the same as that of college students.

B. DIRECT PRIVATE COSTS

Information on current expenditures, tuition, and enrollments for 1940 and 1950 were taken from a special study[16] rather than directly

[14] Many of the persons who leave school after only completing the eighth grade were still in school at ages 14-15 and even 16-17 (see *School and Early Employment Experience of Youth*, Dept. of Labor, No. 1277, Washington, 1960, Tables 5-6). Moreover, the same study indicates that teen-agers not in school have a lot of "unexplained time," i.e., time when they were not in the labor force, in training, sick, etc. (see *ibid.*, Table 20). Possibly these considerations explain the extraordinarily large fraction reporting no income.

[15] Schultz' estimates (*Journal of Political Economy*, December 1960, Table 5) of both actual and foregone earnings are again much larger than ours.

[16] See *Current Operating Expenditures and Income of Higher Education in the United States, 1930, 1940 and 1950* (called *COEIHE* in later references), a Staff Technical Paper of the Commission on Financing Higher Education, Columbia University Press, New York, 1952, Tables 3, 58, 83, 91, and 115.

from the Biennial Surveys of the Office of Education because the study apparently presents more consistent and comparable data.[17] Information from the biennial surveys improved considerably during the 1950's and was used for 1956 and 1958.

Gross tuition and fees would equal reported tuition and fees plus contributions by the federal government to the tuition of veterans. An estimate of tuition paid for extension courses was subtracted since enrollment figures exclude extension students. The estimate assumed that extension tuition was the same fraction of all tuition as current expenditures on extension were of all current expenditures.[18]

The tuition paid by students would be lower than the tuition received by colleges because of scholarships from colleges and other sources. The 1952-53 national sample provides information on scholarships received from both sources: together they averaged about 20.7 per cent of tuition.[19]

Figures on enrollment usually include part-time along with full-time students, and accordingly overestimate the number of full-time equivalents. A special study in 1958 indicated that part-timers were about 24 per cent of all male college students.[20] If part-timers averaged about half the course load of full-timers (they probably averaged somewhat less),[21] the number of full-time equivalents would be about 88 per cent of the total enrollment. All the college enrollment figures, therefore, have been multiplied by 0.88.

All these adjustments transformed the crude figures into full-time tuition charges and payments for nonextension students; payments

[17] See *ibid.*, Introduction, pp. iii to ix.

[18] These ratios were .073 in 1939 and .053 in 1949 (see *ibid.*, Tables 3 and 91).

[19] See *Costs of Attending College*, Table 8. Scholarships from colleges averaged about 13.9 per cent of tuition, which is close to the 12.5 per cent estimate for 1953-54 of John F. Meck (see his *Testimony Before the House Ways and Means Committee, 1958*, General Revenue Revisions, Vol. 78, 85th Congress, 2nd Session, Washington, 1958, p. 1065).

[20] *Total Enrollment in Institutions of Higher Education, First Term, 1959-60*, Washington, 1962, Table 1.

[21] According to some estimates, part-time undergraduate students average about two-sevenths and part-time graduate students about three-fifth of the load of full-timers; together they would average about one-third. For these estimates, see R. W. Wallers, "Statistics of Attendance in American Universities and College, 1949," *School and Society*, December 1949, and S. Mushkin and E. McLoone, *Student Higher Education: Expenditures and Sources of Income in 16 Selected States*, Washington, 1960.

were $112 per student in 1939, $228 in 1949, $209 in 1956,[22] and $242 in 1958, and charges averaged about 25 per cent higher because of college and other scholarships. In recent years the Office of Education surveyed the tuition charged full-time students in a large number of colleges, and found an average of $296 in 1956-57 and $319 in 1957-58.[23] This is generally consistent with my estimates for these years considering the bias in favor of more expensive schools in the Office of Education survey, and the slight upward biases in my estimates of full-time equivalents and extension tuition.

The 1952-53 survey gives the average outlay by college students on books and supplies, travel between home and school, and capital (e.g., typewriters) used in school work. These were assumed to be the only other private direct costs and to be the same fraction of tuition in other years as they were in 1952-53. In that year books and supplies were 22.5 per cent of tuition, travel 23.9 per cent, and capital 7 per cent.[24]

High-school tuition was set equal to zero. The other direct costs of high-school students—transportation, books, etc.—were estimated by assuming that the ratio of these costs to expenditure per student by high schools equaled one-half the observed ratio for college students. The use of one-half is quite arbitrary and perhaps a somewhat different ratio would be more justifiable. However, a considerable change in the values assumed for these other direct costs would not have much effect on the estimated rates of return from high school.

22 The decline from 1949 to 1956 was quite unexpected, but turned out to be rather easily explained. While average tuition per student increased somewhat in private colleges, it decreased substantially in public ones, and the fraction of students in public colleges increased from .51 in 1949 to .56 in 1956. (See "Statistics of Higher Education: Receipts, Expenditures and Property, 1949-50," Section II of *Biennial Survey of Education in the United States, 1948-50,* Washington, 1952, Table 2, and "Statistics of Higher Education: Receipts, Expenditures and Property, 1955-56," Volume II of *Biennial Survey of Education in the U.S., 1954-56,* Washington, 1959, Table X; and *Statistical Abstract of the U.S.-1961,* Table 157.) Average tuition declined in the public institutions partly because the relative number of veterans declined and public institutions were sometimes permitted to charge veterans going to school under the G.I. Bill more than other students.

23 W. Robert Bokelman, *Higher Education Planning and Management Data, 1957-58,* Washington, 1958, Table 34.

24 See *Costs of Attending College,* Table 8. Ten per cent of the capital was assumed to be used up during a single school year. This assumption is discussed in the next section.

C. DIRECT SOCIAL COSTS

Direct social costs equal the sum of current educational expenditures, capital used up on education, and property taxes that would have been levied if schools were not tax-exempt. Educational expenditures are much smaller than total expenditures by schools, since schools are multiproduct institutions (especially at the college level) that do extension work, house and feed students, organize athletic contests, conduct research, and so on. I have excluded from the total what the biennial survey calls "noneducational" expenditures, extension, organized research, and expenditures on "organized activities relating to instructional departments." One might argue that some research and organized activities expenditures should be included since these directly benefit students and make it easier to acquire a good faculty. Expenditures on them were only about 13.6 per cent of other educational expenditures in 1939, but rose to 29 per cent in 1949.[25] Including these expenditures as educational costs would have lowered the estimated rate of return about .75 of a percentage point in 1949—a relatively small difference.

The amount of tangible capital per school was estimated from an unpublished study by Robert Rude.[26] Only 80 per cent of all colleges in his sample reported their capital, so his figure for college capital may be too low; but since those not reporting were quite small, the bias is probably not large. Capital per student was obtained by dividing the amount per school by the number of students per school. The fraction of all capital used on "noneducational" activities (extension, housing, etc.) is assumed to be the same as the fraction of all current expenditures on these activities. If "current" expenditures on research and other noneducational activities include an allowance for capital overhead, some of the capital used on noneducational activities would be subtracted twice.[27] About 37 and 48

25 See *COEIHE,* Tables 58 and 83.

26 See his unpublished manuscript, "Assets of Private Nonprofit Institutions in the United States, 1890-1948," National Bureau of Economic Research, 1954. There is evidence that Rude overestimated the relative value of land (see an unpublished discussion by Z. Griliches).

27 On the other hand, if the current expenditures on research and other "noneducational" activities do not include any allowances for current "overhead," some of the general administrative expenditures and other such "overhead" should be allotted to these activities and excluded from my figures. I did not, however, try to make any adjustment for this.

per cent of college capital in 1939 and 1949, respectively, was excluded from Rude's estimates.[28]

The Office of Education combines expenditures of high schools and elementary schools. The expenditures of each could be estimated from the formula

$$wX + (1 - w)\,\alpha\,X = Y,$$

if w and α were known, where X is the expenditure per student in high schools, Y is the combined expenditure per student, w is the fraction of students in high schools, and $1/\alpha$ is the ratio of expenditures per student in high schools to those in elementary schools. Now w is regularly reported and α is occasionally reported. For example, it was stated that $1/\alpha$ equaled about 1.74 in 1939-40,[29] and I have used this ratio to estimate X, the expenditure per high-school student. High-school capital was assumed to be the same fraction of the combined capital as it was of the combined expenditures. Finally, noneducational expenditures and capital were assumed to be the same fraction of high school as they were of the combined elementary- and high-school expenditures and capital.

The opportunity cost of capital used in education, which measures the rate of return on other capital plus the rate of depreciation on capital in education, was assumed to be 10 per cent of its value per annum. Usually, rates of interest rather than rates of return have been used in measuring opportunity costs, even though the latter seem more appropriate in determining social as well as private costs. In any case, the estimated opportunity cost of capital would not have been much lower if interest rates had been used.

Schools are exempt from property taxes while private businesses are not. In order to compare social rates of return on investments in business and education, either actual property taxes should be added to the net incomes of businesses or implicit taxes to the cost of education. The implicit annual property tax on educational capital was taken as 1.5 per cent of its value.[30] This amounted to $18 per student in 1939 and $21 in 1949, and was added to other educational costs.

[28] The breakdown is as follows:

	1939	*1949*
Noneducational	19.1	21.9
Extension	7.3	5.3
Research	5.6	14.2
Organized activities	5.5	7.1

(See *COEIHE*, Tables 58, 83 and 115.)

[29] See *Statistical Summary of Education, 1939-40*, Vol. II of the *Biennial Survey of Education in the United States, 1938-40*, Washington, 1943, Table 42, footnote 1, p. 44. In 1941-42 it was put at 1.70 (see *Statistical Summary of Education, 1941-42*, Vol. II of the *Biennial Survey of Education in the United States*, Table 38, p. 34).

[30] See Blitz, in *Economics of Higher Education*, p. 161.