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CHAPTER V

Rates of Return from College Education

Virtually all the implications developed in Part One, from income distributions to unemployment, are based on the effect of investment in human capital on earnings and productivity. Consequently, the significance of that analysis can be determined most directly through an empirical examination of the relation between earnings or productivity and human capital. This will be done in the next three chapters for a number of time periods and demographic groups in the United States.

Although an investigation of many kinds of human capital would be illuminating, the absence of readily available data makes it necessary to concentrate primarily on formal education. Fortunately, education is of considerable interest in its own right and a matter of much current concern: laymen, policy-makers, and researchers are all worrying about the role of education in promoting economic and cultural progress, and about ways to improve the educational process. Quantitative evidence on the economic effects of education would add an important dimension to these discussions because all too often they have been based on grossly inaccurate economic notions.

This chapter and the following one estimate rates of return on college education in the United States during recent years, and Chapter VI covers high-school education and earlier years. Rates of return provide the most convenient and complete summary of the economic

effects of education and, therefore, can be used to answer a variety of questions, such as the following:

1. Do relatively few female, nonwhite, and rural high-school graduates attend college primarily because of relatively low rates of return, or because of financial difficulties, discrimination, and still other factors?

2. Are private rates of return higher on education than on physical capital and, if so, is the explanation to be found in risk, ignorance of effects, nonpecuniary factors, or imperfections in the capital market? Has the large subsidy to education reduced its social rate of return below that on other capital, or has the subsidy been an inadequate response to a very large discrepancy between social and private returns from education?

3. Do more intelligent persons receive higher rates of return from education than others?

4. Has the large secular growth in education caused a decline in returns from education, or has the growth itself been induced by an increase in returns?

The materials analyzed in these chapters shed appreciable light on these and other questions, although, of course, definitive answers are not provided.

This chapter presents estimates of rates of return to urban white males who graduated from college after 1939, estimates for college dropouts, and estimates for college-educated women, nonwhites, and rural persons. Considerable attention is paid to determining the dispersion in rates of return on college education.

1. Money Rates of Return to White Male College Graduates

Returns in 1939

The effect of education on income could easily be determined if information were available on the income of units differing only in education, for then differences in income could be attributed solely to differences in education. These could be geographical units, as countries or states; time units, as the United States today and, say, fifty years ago; or individuals, as college and high-school graduates in the United States. Unfortunately, units differing in education also tend to differ in other factors that influence incomes. For example, higher-income geographical units also tend to have more physical capital per person, while college graduates tend to be abler than high-

school graduates. In other words, the raw information has to be standardized for other factors in order to isolate the effect of education. A few attempts have been made to standardize the information on geographical units, and although interesting qualitative results have emerged, only a limited quantitative analysis has been possible.[1] I decided to exploit the extensive data available for the United States since the 1930s on the earnings and incomes of persons with different amounts of education because they seemed most capable of yielding quantitative, although admittedly rough, estimates of rates of return on education.

The national data on the incomes of persons at different educational levels provided by the 1940 and 1950 Censuses can be supplemented during the 1950s with smaller surveys. Table 2 shows absolute and percentage differences in mean earnings during 1939 at various age classes between urban, native white, male college and high school graduates. Average earnings computed from the 1940 Census were uniformly adjusted upward by 10 per cent because of the underestimation of wages and salaries in the Census data. They were also corrected for the abnormally large unemployment in 1939 so that the data could reflect a more normal economic situation.[2] The adjustment for underestimation raises absolute earning differentials but not percentage ones, while the adjustment for unemployment lowers percentage differentials but does not change absolute ones very much. Since only persons with at least $1 of wages or salaries and less than $50 of other income are covered in the 1940 Census, independent professionals and many other persons were excluded. In order to expand the coverage, the earnings of college graduates were considered to be a weighted average at each age of the earnings of college graduates given by the Census and of independent doctors, lawyers, and dentists given elsewhere, the weights being the number of persons in each group. Both the absolute and percentage differences in columns 2 and 1 of Table 2 are substantial and rise with age, averaging about $1100 (in 1939 dollars) and 45 per cent, respectively, and rising from $450 and 30 per cent at about age 27 to $1700 and 60 per cent at about age 50.

Since Table 2 gives the income gains of surviving members of different cohorts, one way to relate costs and returns would be to compare these gains with the college costs of the different cohorts. Another,

[1] One exception is a study by Zvi Griliches of the effect of education on agricultural output using counties as the unit of analysis (see his "The Sources of Measured Productivity Growth: United States Agriculture, 1940–60," *Journal of Political Economy*, August 1963, pp. 331–336).

[2] A detailed discussion of these and other adjustments can be found in Appendix A.

TABLE 2

Actual Earning Differentials between Urban, Native White, Male College and High School Graduates in 1939 at Various Ages

Age	*Percentage* (*1*)	*Absolute* (*2*)
23–24	4	51
25–29	29	455
30–34	47	949
35–44	56	1449
45–54	59	1684
55–64	53	1386
18–19	−108	−557
20–21	−95	−805
22	−46	−487

Source: Basic data from *1940 Census of Population, Educational Attainment by Economic Characteristics and Marital Status*, Bureau of the Census, Washington, D.C., 1947, Table 29, p. 148. M. Zeman estimated mean incomes at various age and education classes from the Census data (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). These data were adjusted for the underreporting of professional earnings (see my Table A-6), the underreporting of wages and salaries (see Table A-4), and unemployment (see Table A-5). Cost estimates in the last three rows of the table were obtained by the methods discussed in Appendix A.

and for my purposes easier, way would be to compare the costs and returns of a given cohort as it ages over time. Since these data are not directly available, the returns to different cohorts as of the moment in time have to be converted into returns to a given cohort aging over time.

The average earnings of a cohort at any age is a weighted average of the earnings of survivors and of those dying earlier. Obviously the latter earn nothing after they die, so the weighted average can be computed simply by multiplying the earnings of survivors by the frac-

tion surviving. Accordingly, the average earnings in 1939 of different cohorts were multiplied by life table survivorship rates[3] to help convert them into earnings at different ages of a single cohort. Since the same rates were used for high school and college graduates (although a slightly higher rate should have been used for the latter), percentage earnings differentials were unaffected while absolute ones were lowered, especially at older ages.

The secular growth in real earnings per capita would usually enable the cohort of persons graduating from high school or college in any year to earn more at each age than was earned in that year by persons who had graduated earlier. Earnings received in 1939 have to be adjusted upward, therefore, if they are to represent the earnings of cohorts graduating in 1939. Only part of the substantial rate of growth since 1939 in earnings per capita can be used in the adjustment, however, because much of the growth in earnings resulted from the increase in education itself. Moreover, earnings did not grow at the same rate in all age and education categories. Not being able to make an exhaustive study, I simply assumed that if $d(t)$ were the differential observed in 1939 between cohorts graduating from college and high school t years earlier, the differential t years later for cohorts who had graduated in 1939 would be $d(t)(1+g)^t$, where g is the annual rate of growth in the differential. The most plausible value for g seems to be about .0125, although results are also presented for $g = 0$ and $g = .02$.[4]

Cross-sectional and cohort earnings also differ in several other respects. For example, the former are much more affected by business cycles, and, consequently, as already mentioned, the 1939 data had to be adjusted for the depressed economic conditions at that time. An interesting difference can be found in the adjustment for income tax payments required to convert before-tax returns into private returns. In 1939 tax rates were low and so only a minor adjustment need be made to incomes received at that time. A much more substantial adjustment, however, has to be made to the incomes of cohorts gradu-

[3] They should also be multiplied by labor force participation rates because the 1940 Census only includes persons with at least $1 of earnings in 1939. Experiments on the 1950 Census data indicate, however, that this adjustment has only a slight effect on the results.

[4] According to E. Denison, national income per capita has grown at a rate of 1.7 per cent per annum from 1929 to 1957 and about 25 per cent of this was due to the growth in years of education (see his *Sources of Economic Growth in the United States*, Committee for Economic Development, Washington, 1962). His Table 33 fixes the contribution of education at more than 40 per cent, but it is clear from his derivation that half of that was due to the increase in the number of days of attendance in each school year, which should *not* be excluded from our adjustment.

ating in 1939 because they received the bulk of their incomes in the 1940s and later, and taxes have risen substantially during these years. Accordingly, two alternative adjustments have been made: one is simply based on the 1939 tax rates, while the other utilizes the much higher rates prevailing in 1949 to approximate the effects of the different tax rates in the 1940s, 1950s, and 1960s.

Costs in 1939

Total private costs of attending college can be considered the sum of private direct and indirect costs. The former includes tuition, fees, outlays on books and supplies, and any living expenses beyond what would be incurred when not in college. Average tuition and fees per college student in 1939 and other years can be estimated without too much trouble from data collected by the Office of Education. Books and unusual living expenses can be estimated from other surveys, notably a large national sample taken by the Education Office in the 1950s. Private direct costs per student averaged about $173 in 1939, of which 65 per cent or $112 were tuition and fees.

Since students earn less than if they were participating full time in the labor force, the earnings foregone are an indirect cost of schooling. The amount foregone depends both on the number of hours spent at schoolwork and the opportunities for part-time (after school) and seasonal (summer) work. The latter determinant is quite sensitive to business conditions and the age, race, sex, etc., of students, so indirect costs vary more over time and among demographic groups than direct costs do.[5]

[5] For the purpose of estimating rates of return, it is only necessary to recognize—as everyone must—that students earn less than if they were participating in the labor force. This difference in earnings need not be called a cost of education nor related to direct costs. However, foregone earnings are treated as a cost here and throughout the book, because such a treatment adds to the understanding of the economic effects of education (and other human capital). Moreover, the arguments advanced against doing so cannot withstand close scrutiny. To take one prominent example, John Vaizey, who has written extensively on the economic effects of education, in arguing against the inclusion of foregone earnings, said: "for young people there is no alternative; the law forbids them to work," or "if income foregone is added to education costs it must also be added to other sectors of the economy (notably housewives, mothers, unpaid sitters-in, voluntary work of all sorts)" and "Analytically, too, it would be necessary to adjust the costs by some notional estimate of benefits incurred while being educated" (see his *The Economics of Education*, Glencoe, 1962, pp. 42–43). Now if foregone earnings are excluded because schooling is compulsory, surely direct costs have to be excluded also. If the foregone earnings of other activities are important, then, of course, they should be treated as costs too

Indirect costs were estimated by assuming that the typical person attends college from the age of eighteen to twenty-two and one-half and earns one-quarter of what he could have earned. Four and a half years of college are assumed because the Census group with "sixteen +" years of schooling appears to have that much undergraduate and postgraduate training.[6] The one-quarter assumption is based on the notion that college attendance is a full-time occupation for three-quarters of a year—vacations occupying the remaining quarter—for which notion there is direct evidence provided by several studies.[7] In principle, the potential earnings of first-year college students should be measured by the actual earnings of otherwise equivalent persons who entered the full-time labor force after completing high school, the potential earnings of second-year students by the actual earnings of otherwise equivalent persons who entered the labor force after completing one year of college, and so on. Limitations of data necessitated the use of a simpler, but not too inaccurate, method. The potential earnings of students during the first four years of college were measured by the actual earnings of "equivalent" high school graduates of the same age, and potential earnings during the last half year of study by the earnings of college dropouts of the same age.

The last three rows of Table 2 show absolute and percentage differentials from ages eighteen to twenty-two between the net earnings of college students and high-school graduates. "Net" earnings means that direct college costs have been subtracted from the earnings of college students. The total private cost of attending college for the average urban native white male in 1939 is roughly measured by the series of absolute differentials. Foregone earnings account for about 74 per cent of the total, tuition and fees for only about 17 per cent, and other direct costs for the remaining 9 per cent. Therefore, if tuition and fees alone were eliminated—if colleges were made "free" in the usual meaning of this term—only a relatively small part of the private burden of attending college would be eliminated. That is to say, even at the private level "free" colleges are not really very free after all!

(and are in my paper *A Theory of the Allocation of Time*, IBM Research Paper RC-1149, March 20, 1964, a shorter version of which was published as "A Theory of the Allocation of Time" in the *Economic Journal* of September 1965). Finally, that benefits are incurred while being educated is no more an argument against the inclusion of indirect costs than against the inclusion of direct costs.

[6] See P. C. Glick and H. P. Miller, "Education Level and Potential Income," *American Sociological Review*, June 1956, p. 311.

[7] See Appendix A, section 2a.

Rates of Return in 1939

The monetary gain from attending college can be determined from a comparison of returns and costs. A person deciding whether or not college "pays" should discount both the streams of returns and costs in order to incorporate the basic economic fact that $1000 promised in ten years is worth less than $1000 available today. Discounting of future income is incorporated into the internal rate of return, which is simply a rate of discount that makes the series of absolute earnings differentials between college and high-school graduates sum to zero.[8] One could also compute the present value of the monetary gain, which is the sum of all absolute differentials *after* they have been discounted at appropriate market interest rates (see Chapter III). Both methods are used in this chapter, although greater attention is paid to the internal rate.

Since the concern is with the gain achieved by cohorts, the data in Table 2 have to be adjusted for mortality, growth, and taxation. Note that both measures of monetary gain use absolute, not percentage, earning differentials, so any adjustment changing the former would change the estimated gain, even if the latter were not changed. Thus the adjustments for mortality and growth do not change percentage differentials, but, as shall be seen, they do significantly alter the estimated gain. Note further that the rate of return to a cohort can be computed either from the stream of total (cohort) absolute differentials or from the mean (that is, per capita) differentials. Likewise, the present value of the gain can be computed either from total differentials or on a per member basis from mean differentials. There has been considerable controversy over whether mean or median differentials are the more appropriate measure of the central tendency of returns (and presumably also of costs) to education. Means are clearly more appropriate when calculating *cohort* gains; perhaps medians are better for other purposes.[9]

Table 3 presents several alternative estimates of the private rate of return to the cohort of urban native white males graduating from college in 1939. The estimates increase a little over 1 percentage point for each percentage point of increase in the secular growth in earn-

[8] The internal rate does not, however, necessarily equate the present values of returns and costs (see the discussion in Chapter III).

[9] Edward Renshaw prefers the median to the mean for reasons I find largely unconvincing. See his "Estimating the Returns to Education," *Review of Economics and Statistics*, August 1960, p. 322.

TABLE 3

Alternative Estimates of Rates of Return to 1939 Cohort of Native White Male College Graduates (per cent)

Secular Rate of Growth in Earnings (per cent)	*Straight 4 Per Cent Tax Rate (1)*	*1949 Actual Tax Rates (2)*
2	16.8	15.3
1	15.6	14.1
0	14.4	13.0

ings, and are about 1.5 percentage points lower when the tax rates prevailing in 1949 are used in place of those in 1939. A figure of slightly over 14.5 per cent is probably the best single estimate of the rate. This figure and indeed *all* the estimates indicate a very substantial private gain to white male college graduates.

The dominance of foregone earnings and the relative unimportance of tuition can be vividly demonstrated with rate of return calculations. The gain from attending college would, of course, increase if any component of cost decreased. But while the complete elimination of tuition would increase the rate of return to these college graduates only by a little over 1 percentage point, the elimination of foregone earnings would almost double it. Thus, good economic reasons, as well as lack of information and motivation, may prevent poorer high school graduates from attending even tuition-free colleges. The elimination of foregone earnings, which incidentally has never been tried on a large scale in the United States, should have a much greater effect on their incentive to go to college.

Rates of Return in 1949

Independent estimates of the rate of return to college graduates can be based on data collected by the 1950 Census. Table 4 presents absolute and percentage differentials between the net incomes of college and high school graduates in 1949, where net income means that direct costs have been subtracted from the earnings of college graduates at ages 18 to 22½. I tried to approximate the returns and costs of the cohort of persons graduating from college about 1949 by adjusting these figures for mortality, growth, and taxation. The mortality adjustment was based on rates prevailing in 1949, and income differen-

TABLE 4

Earning Differentials between White Male College and High School Graduates in 1949 at Various Ages

Age	*Percentage* (*1*)	*Absolute* (*2*)
23–24	−16	−372
25–29	+8	+230
30–34	42	1440
35–44	86	3419
45–54	100	4759
55–64	85	4068
18–19	−111	−1073
20–21	−95	−1647
22	−59	−1324

Source: *United States Census of Population: 1950, Special Reports—Education*, Bureau of the Census, Washington, 1953, Vol. IV, Part 5, Chapter B, Table 12. Cost estimates used in the last three rows of the table were obtained by the methods discussed in Appendix A.

tials were again assumed to grow at a little over 1 per cent per annum. The tax adjustment was based on the incidence of the personal income tax in 1949, although a somewhat greater adjustment would be more appropriate as taxes have risen a little since 1949. No adjustment for unemployment is necessary since 1949 was a rather normal economic year.

The private rate of return to the 1949 cohort would be 12.7 per cent if income differentials grew at 1 per cent per annum, and about 1 percentage point higher or lower if they grew at 2 per cent or not at all. Probably the best single estimate is close to 13 per cent, somewhat lower than the 14.5 per cent estimate based on the 1940 Census data. Their general agreement increases the confidence that can be placed in the statistical (as opposed to conceptual) reliability of our calculations.

Is the slight decline between 1939 and 1949 indicative of a general secular decline in the monetary gain from education? Secular changes are discussed in Chapter VI, so now I shall only consider whether the apparent decline is spurious owing to a shift in the statistical base.

The 1949 data refer to the total incomes of all whites, while the 1939 data refer only to the earnings of urban native whites. For obvious reasons, the inclusion of property income raises the estimated return in 1949, although probably not by very much (see Appendix A). While the direction and, a fortiori, the magnitude of the effect of the other differences is more difficult to determine,[10] they probably cannot fully explain the apparent decline during the 1940s.

2. Some Conceptual Difficulties

Correlation between "Ability" and Education

Although the similarity between the estimates derived from the 1940 and 1950 Censuses should increase one's confidence in the statistical foundations of the analysis, it does not make the conceptual foundations any firmer. And the technique of estimating the private rate of return on education from income differentials between persons differing in education has been repeatedly and strongly attacked. Simply worded, the argument is that the true rate of return on education is grossly overestimated because persons differing in education also differ in many characteristics that cause their incomes to differ systematically. By explicitly considering the variation in earnings with age and by restricting the analysis to persons of a given sex, race, and in 1939 urban-rural and nativity status, I have already managed to eliminate the more important demographic sources of bias.

Unquestionably the most serious remaining difficulty results from the presumed positive correlation between education and "ability," which has been argued with fervor by intelligent persons in the United States and many other countries. Moreover, the theory developed earlier implies that abler persons invest more in themselves, at least when "ability" is defined in an economic sense (see Chapter III, section 3). Finally, the available quantitative materials definitely show a positive relation between education and several measures of ability. Table 5 summarizes some evidence on the abilities of high-school and college persons in the United States in the 1950s. In columns 1 and 2 "intelligence" is measured by the average IQ (intelligence quotient) and the fraction with high IQs; in column 3 a combination of intel-

[10] For example, rural and foreign-born whites generally have less education, lower incomes at each education level, and a lower return from additional education than urban native whites do. The first two factors would increase, the third decrease, the rate of return estimated for 1949.

TABLE 5

Several Measures of Ability at Different Educational Levels in the 1950s

Education	*Average IQ*[a] (*1*)	*Percentage with IQ Over 120*[a] (*2*)	*Average Rank in High School Graduating Class*[b] (*percentile*) (*3*)	*Percentage with Fathers in Professional, Semiprofessional, or Managerial Occupations*[c] (*4*)
High school graduate	106.8	20.8	44	22
College graduate	120.5	50.0	68	45
College dropout	106.2	16.3	48	44

Source: Dael Wolfle, *America's Resources of Specialized Talent*, New York, 1954. Columns 1–3 computed from Table G.2, p. 314, and Table H.1, p. 316; column 4 from Table VI.6, p. 160, and Table VI.7, p. 162.

[a] The IQ estimates, based on the Army General Classification Test, are for 1953 and were based partly on special studies conducted by the Commission on Human Resources and partly on estimates made by others. Among the latter is the study by V. Benson, "The Intelligence and Later Scholastic Success of Sixth Grade Pupils," *School and Society*, February 1942. Her data are especially interesting because the subsequent education of children receiving IQ tests in the sixth grade was determined. Therefore, the positive relation between IQ and education in her study—which shows differences similar to those given above—cannot be considered a consequence of the education itself.

[b] These data on grades are national estimates prepared by the Commission for 1953. Almost identical results are given in the Bureau of the Census study *Factors Related to College Attendance of Farm and Nonfarm High School Graduates: 1960*, Series Census-ERS (P-27) No. 32, Washington, 1962, Table 8.

[c] The distributions by father's occupation omit children with fathers in farm occupations and are rough estimates prepared by the Commission from the 1950 Census. Similar differences by father's education and income are given in *School Enrollment and Education of Young Adults and Their Fathers: October 1960*, Bureau of the Census, Washington, 1961, Tables 9–10.

ligence, interest in schooling, and perseverance is measured by the average rank in high school; and in column 4 a combination of "contacts," tastes, and knowledge about better-paying occupations is measured by the fraction with fathers in professional, semiprofessional, and managerial occupations. All suggest significantly greater ability among college than high-school graduates: an average IQ about 13 per cent higher, over twice the rate of IQs above 120, a 50 per cent higher class ranking in high school, and a 100 per cent larger number with fathers in the top occupations.

Although general observation, theoretical analysis, and quantitative evidence suggest a strong correlation between ability and education, what can be said about the magnitude of the bias in rate of return estimates based on the income differential approach used in the last section? In particular, is most of the apparently large return to college graduates due to their greater ability, or only, say, 10 per cent? Neither general observation nor theoretical analysis has much to suggest about this, so considerable reliance has to be placed on the limited quantitative evidence, derived from five main independent methods presented below. The evidence suggests that this correlation explains only a small part of the apparently large return. Let me point out, however, that the discussion in Chapter VI concludes (see section 1) that much of the large apparent return to primary and secondary school education does result from differential ability.

1. It would be desirable to recalculate the rates of return presented earlier after the data had been fully standardized for ability. Either the incomes of college graduates could be standardized for the distribution of ability among high-school graduates, or the incomes of the latter could be standardized for the ability of the former. The first method would determine the rate of return to a typical high-school graduate who decided to enter college, while the second would indicate the rate actually received by a typical college graduate. The latter would be greater if college graduates were abler and if abler persons benefit more from college.

Table 5 indicates that rank in class is strongly related to extent of education, so its effects are considered first. A good source of information on the relation between rank and earnings is the study of college graduates employed by the Bell Telephone Company. Rank in college did not affect starting salaries much, but after fifteen years the employees who had been in the top two-fifths of their college class earned about 20 per cent more than those in the bottom two-fifths, and in later years the differences were still greater.[11] The differences after fifteen years seem to be a good measure of the average relation between college rank and earnings.[12]

According to column 3 of Table 5, the typical person who did not

[11] See Donald S. Bridgman, "Success in College and Business," *The Personnel Journal*, June 1930. A more recent and comprehensive study, as yet unpublished, appears to give very similar results.

[12] If earnings of abler graduates rise more rapidly with age partly because of greater investment on the job and in other human capital (see Chapter II, section 1), the extent of the relation between rank and earnings would be underestimated by the differentials at younger ages and overestimated by those at older ages. Differentials after fifteen years of employment tend to avoid the extremes of either bias.

go to college after finishing high school ranked much lower in high school than persons who completed college. Presumably, the former would also have ranked much lower in college if he had gone on. Consequently, according to the Bell data, he would also have earned less, perhaps a good deal less, than college graduates actually do. To be concrete, he would have earned about 7 per cent less if the Bell data accurately measure the relation between college rank and earnings, and if high-school and college graduates would have had the same relative ranking in college as they had in high school.[13]

Income differentials between college and high-school graduates would, therefore, significantly overstate the gain to a typical high-school graduate from completing college, for at ages 35 to 44 (roughly fifteen years after completing college) 7 per cent of college graduates' incomes equals almost 20 per cent of the apparent gain from college.[14] The rate of return estimates would be reduced by a smaller percentage. The best estimate of the private rate would be reduced from about 14.5 to a little over 12.5 per cent for the 1939 cohort and from 13 to about 11.5 per cent for the 1949 cohort, or an average reduction of about 12 per cent.[15]

2. An adjusted rate of return to a typical college graduate could be computed if the relation between rank and the earnings of high-school graduates were known. Unfortunately, the Bell study did not collect information on the earnings of high-school graduates. But this as well

[13] If E_i is the average earnings of college graduates who were at the i^{th} rank level in college, and if d_{ih} and d_{ic} give the proportion of college and high school graduates who would have been at this level, the ratio of their earnings after college would be

$$p = \frac{\Sigma E_i d_{ih}}{\Sigma E_i d_{ic}}.$$

If E_1 covers the top two-fifths, E_2 the third fifth, and E_3 the bottom two-fifths, then, according to the Bell Telephone study, $E_1 = 1.18E_3$ and $E_2 = 1.02E_3$. Data from the Commission on Human Resources indicate that 68 per cent of persons graduating from college were in the top two-fifths of their high-school class, 17 per cent in the third fifth, and 14 per cent in the bottom two-fifths, while only 32 per cent of high-school graduates not going on to college were in the top two-fifths, 20 per cent were in the third fifth, and 48 per cent in the bottom two-fifths (see Wolfle, *America's Resources,* Appendix H, Table 1). Substituting these figures into the equation gives $p = .93$.

[14] It is about 19 per cent of the apparent gain to the 1939 cohort of college graduates and 16 per cent of that to the 1949 cohort.

[15] The adjusted rates probably should be slightly lower because the direct college costs of a typical high-school graduate were assumed to equal the actual average direct costs of college graduates, even though the former's tuition would probably be somewhat higher since colleges engage in "price discrimination" against persons with lower high-school ranks. Since the assumption that college students earn one-quarter of the amount earned by high-school graduates of the same age already incorporates a correction for the differential ability of college students (see Appendix A, section 2a), no adjustment of indirect costs would be necessary.

as other useful information can be found in a study of Wolfle and Smith.[16] They obtained annual salaries some fifteen to twenty years later of about 2800 male graduates of high schools in Illinois, Minnesota, and Rochester, N.Y., in the middle and late 1930s. Most of the persons included from Illinois and Minnesota were in the upper 60 per cent, either in class standing or IQ, while the Rochester sample (which was smaller) was limited to persons in the top 20 per cent on either measure.

The top panel of Table 6 presents the relation between percentile rank in high school, median earnings, and education for the whole sample. The Bell study gives the relation of college rank, this one (in column 3) the relation of high-school rank, to the earnings of college graduates. Those at the top earn significantly more than those at the bottom of their high-school class, where the bottom 1–60 percentile class actually is largely restricted to persons in the 40–60 percentile class. Indeed, the relation of rank and the earnings of college graduates given here is almost exactly the same as that given in the Bell study. Fifteen years after graduation, persons who had been in the top two-fifths of their class were earning 16 per cent more than those in the third fifth, according to the latter study, and averaged about $6600, compared to the $5700 earned by those in the third fifth, according to the former study. Thus, rank-adjusted rates of return to typical high-school graduates computed from these data would be essentially the same as those computed earlier from the Bell study.

The stub entries in Table 6 provide the data necessary to compute rank-adjusted returns to typical college graduates. However, since there was little systematic relationship[17] between rank and the earnings of high-school graduates, no adjustment is required. The typical college graduate apparently receives a higher rate of return from college than would a typical high-school graduate, because the former has a higher class rank, and the payoff from college is greater for those with higher ranks. Indeed, this greater payoff is presumably an important reason why persons with higher class ranks go to college much more frequently than others do.[18]

[16] See D. Wolfle and J. Smith, "The Occupational Value of Education for Superior High School Graduates," *Journal of Higher Education*, April 1956, pp. 201–213.

[17] At least within the top sixtieth percentile, which is essentially all that is relevant to the typical college graduate.

[18] Almost 50 per cent in the top two-fifths of their high-school class go to college, while only 22 per cent in the bottom two-fifths go (see Wolfle, *America's Resources*, Table VI-2, p. 150). For similar results, see *Factors Related to College Attendance*, Table 9. Some studies indicate, moreover, that rank increases the likelihood of attending college even when the parents' economic position is held constant. See *ibid.*, Tables 14–16; also see some references in C. C. Cole, *Encouraging Scientific Talent*, New York, 1956, pp. 57 ff.

TABLE 6

Median Salaries of Illinois, Minnesota, and Rochester Men, by Rank in High School Graduating Class and by Intelligence Test Score (dollars)

	Education		
Ability Measure	*High School* (1)	*Some College* (2)	*One College Degree or More* (3)
Percentile rank in high school class[a]			
91–100	4880	5600	7100
81– 90	4780	5400	6300
71– 80	4720	5300	6500
61– 70	4810	5700	5700
1– 60	4655	5300	5700
Intelligence test, percentile in sample[b]			
Highest 20	4000	5300	6300
Next 35	4500	5200	6100
Bottom 45	4300	4100	5200
Intelligence quotient[c]			
Over 120	5500	6100	7600
Under 120	5000	5700	7400

Source: Dael Wolfle and Joseph Smith, "The Occupation Value of Education for Superior High School Graduates," *Journal of Higher Education*, April 1956, pp. 201–213, Tables II, IV, and V.

[a] Illinois, Minnesota, and Rochester men.

[b] Minnesota men.

[c] Rochester men.

The bottom two panels of Table 6 give the effect of IQ on earnings. The Rochester data are derived from a small and highly restrictive sample. The Minnesota data are more interesting since they cover persons with IQs mostly above the top sixtieth percentile of all high-school students. This sample indicates that an increase in IQ has the same kind of effect on earnings as an increase in rank: a negligible effect among high school graduates[19] and a 15 to 20 per cent effect

[19] One should point out, however, that high school graduates with high IQs and high grades may not go to college precisely because they rank low in other kinds of ability. This may explain why they do not earn much more than other high school graduates.

among college graduates. So an adjustment for IQ alone would reduce the apparent gain from college by about the same amount as the adjustment for rank did. These effects cannot, however, be added together to get the effect of simultaneously adjusting for rank and IQ since they are very highly correlated.[20] Therefore, adding an IQ adjustment to the rank adjustment would lower the rate of return to a typical high-school graduate probably by less than 0.5 of a percentage point: from 12.5 to 12.0 per cent for the 1939 cohort and from 11.5+ to 11+ per cent for the 1949 cohort. The rate of return to an average college graduate would hardly be reduced at all, and would remain near 14.5 and 13 per cent for the 1939 and 1949 cohorts, respectively.

The Wolfle-Smith study also contains useful information on the relation between father's occupation, education, and earnings. Once again the effect is much greater at the college level. College graduates with fathers in professional or managerial occupations earned about 16 per cent more than those with fathers in unskilled or service occupations, while high-school graduates with fathers in top occupations earned only about 4 per cent more. Therefore, an adjustment for father's occupation alone would hardly reduce the gain to a typical college graduate and would reduce the gain from college to a typical high-school graduate by about 7 per cent.[21] Again, the high correlation between rank, IQ, and father's occupation implies that the effect of adjusting for father's occupation, in addition to adjusting for rank and IQ, would be much less than if it were the sole adjustment.

This discussion of the data provided by the Committee on Human Resources can now be summarized. Even if rank in high school, IQ, and father's occupation are adjusted for separately, the rate of return from college to a typical college graduate would hardly be affected, while that to a typical high-school graduate would be reduced by about 35 per cent. College education itself would be the major determinant of the apparently high return associated with education. Moreover, the sum of the separate effects grossly overstates the combined effect, since rank, IQ, and father's occupation are quite closely correlated. Thus, the fraction of the unadjusted return attributable to college education itself would be very high.

[20] See Wolfle, *America's Resources*, Appendix H, Table 1.

[21] The effect on income can be found from the formula in footnote 13 above where the index i would now refer to father's occupation rather than school rank. The distribution of high-school and college graduates by father's occupation can be found in Wolfle, *America's Resources*, Tables VI.6 and VI.7, pp. 160 and 162. Substituting these weights and the data on earnings given by Wolfle and Smith (*Journal of Higher Education*, April 1956) into the formula gives $p = .963$. The adjusted rate of return would then be estimated at a little more than 13.5 and 12 per cent instead of 14.5 and 13 per cent for the 1939 and 1949 cohorts.

3. J. Morgan and M. H. David published an interesting attempt to isolate the effect of education on earnings through standardization by multiple regression for other influences.[22] In one set of regressions, they adjusted the family earnings of white male heads of nonfarm households in the labor force for measures of religion, personality, father's education, labor market conditions, mobility, and supervisory responsibilities. The share of the unadjusted earnings differential between college and high-school graduates explained by these factors was about 40 per cent at ages 18 to 34 and 12 per cent at ages 35 to 74.[23] In other regressions, measures of rank in school and ability to understand and answer questions were of negligible importance.[24] Hence, in their sample, too, college education itself is the major cause of differentials between college and high-school graduates, especially when one recognizes—as Morgan and David do—that supervisory responsibility and mobility are primarily simply means through which the economic effects of education operate.[25]

4. A very different way to eliminate the influence of several dimensions of ability is to consider the earnings of college dropouts. Table

[22] See their "Education and Income," *Quarterly Journal of Economics*, August 1963, pp. 423–437. The data were collected by the Survey Research Center from a national sample of approximately 3000 heads of spending units.

[23] See *ibid.*, Table III. These results refer to college graduates with a bachelor's degree only and high-school graduates without any nonacademic (presumably formal) training. The results for persons with advanced degrees and nonacademic training are about the same. However, differentials between all college and all high-school graduates could not be computed because the number of cases in each group was not given.

[24] *Ibid.*, pp. 428–429. For an earlier and in some ways more complete discussion, see J. Morgan, M. H. David, W. J. Cohen, and H. E. Brazer, *Income and Welfare in the United States*, New York, 1962, Chapter 5.

[25] In general, when standardizing by multiple regression or some other technique to obtain the effect of education on earnings, one must be careful not to go too far. For education has little direct effect on earnings; it operates primarily indirectly through the effect on knowledge and skills. Consequently, by standardizing for enough measures of knowledge and skill, such as occupation or ability to communicate, one can eliminate the entire true effect of education on earnings.

This comment is relevant not only to the Morgan-David study, but also to several others, such as an interesting dissertation by Shane Hunt (see "Income Determinants for College Graduates and the Return to Educational Investment," unpublished Ph.D. dissertation, Yale University, 1963). He utilizes a survey in 1947 by *Time* magazine of the incomes of college graduates and finds that graduates of relatively expensive colleges received about a 12 per cent crude rate of return on their additional costs, i.e., those not incurred by graduates of relatively cheap colleges. After standardization for several variables, he cuts the rate substantially. Among those held constant, however, are variables, like occupational category, which clearly partly measure the way in which education affects earnings. Nevertheless, even after all his adjustments, higher-quality college education still yields a significant gain, which is about half the crude gain.

4 indicates that college entrants who drop out before completing four years do not have higher IQs or grades than high-school graduates. True, the same table indicates that the former came from higher social and economic backgrounds, but they were unable to finish an activity that they had started,[26] and so their advantage may be counterbalanced by lack of sustained effort. College dropouts, therefore, do not seem to have much, if any, greater "ability" than high-school graduates (see the discussion in section 3 below). If so, unadjusted rates of return to dropouts would in effect already standardize for ability and would not overestimate the true payoff to some college.

In section 3 below unadjusted rates of return to the 1939 and 1949 cohorts of college dropouts are estimated at about 9.5 and 8 per cent, respectively. Even if these are used to measure the adjusted gain to college graduates, almost two-thirds[27] of the apparent gain from college can be attributed to the education itself. Moreover, the adjusted gain to graduates is probably still larger because the gain from the third, fourth, and later college years is somewhat greater than that from earlier years (see section 3 below).

5. A study during the late 1920s adjusted for ability in a rather unique way, namely, by considering the incomes of brothers with different amounts of education.[28] Since brothers come from the same economic and social background, and presumably differ less in native ability than typical elementary, high-school, and college persons, many kinds of ability often considered important in explaining earning differentials would be held constant. On the other hand, some brothers may become relatively well-educated precisely because of unusual ambition and other kinds of ability rather than because of interest, "luck," and other factors uncorrelated with earnings. Therefore, the study probably does not entirely correct for differences in ability.

Tables 17 and 18 in Chapter VI indicate that the effect of education on income was substantial among these brothers: for example, those averaging 15.5 years of schooling earned about $834 more than those averaging 10.8 years, or about $175 per school year. Lacking reliable income data for the 1920s, this gain will be compared with the unadjusted gain in 1939. One difficulty here is that the Census data are known to understate earnings and to omit the foreign-born,

[26] Of course, some persons discontinuing school after graduation from junior college, because of marriage, etc., may not have planned to finish four years of college.

[27] That is, $9.5 \div 14.5 = .65$ and $8 \div 13 = .62$.

[28] See Donald E. Gorseline, *The Effect of Schooling Upon Income*, Bloomington, 1932.

the self-employed, and some other categories of whites, while the biases in the data on the brothers are not known. So the brothers' differentials will be compared with both raw and corrected Census differentials. In 1939 prices the brothers' gain at ages thirty to thirty-four would be 67 per cent of the gain per school year to college graduates based on 1940 Census data corrected for underreporting of earnings and independent professionals, and 81 per cent of the uncorrected gain. So these data also indicate that college education itself explains most of the apparent gain to college graduates.[29]

Five independent adjustments for differential ability—adjustments that cover such diverse influences as rank in class, IQ, father's education and occupation, personality, ability to communicate, motivation, and family upbringing—all suggest that college education itself explains most of the unadjusted earnings differential between college and high-school graduates. Although any one study is subject to many qualifications, the evidence provided by all taken together has to be given considerable weight. Consequently, it may be concluded that, even after adjustment for differential ability, the private rate of return to a typical white male college graduate would be considerable, say, certainly more than 10 per cent.

A reader might well wonder how this conclusion squares with the evidence, from general observations and theory, advanced earlier that ability and education are quite highly correlated. These observations may have been based primarily on relations below the college level,[30] and as already pointed out, the discussion later on (in Chapter VI) indicates that differential ability has a greater impact there. The theory developed in Part One suggests a positive correlation between ability and education, in that high-school graduates who go to college would receive a higher rate of return from college than graduates who do not go. The limited evidence available supports this suggestion, for data from the Commission on Human Resources do indicate that a typical college graduate gains more from college than would a typical person dropping out after completing high school. Even the latter, however, would receive a high rate of return.

[29] Since these brothers were on the average only about thirty years old, perhaps their gain should be compared to that received by the Census category aged 25 to 29. Such a comparison would increase the fraction of the Census differentials attributable to college education itself. On the other hand, brothers with more education were about two years older on the average than those with less education, so the apparent effect of more education is in part an effect of older age.

[30] A more cynical explanation would be that vocal observers are themselves primarily successful college graduates and, therefore, naturally biased toward the view that ability is a major cause of the high earnings received by college graduates.

Correlation between Education and Other Human Capital

A correlation between the amount invested in education and in on-the-job and vocational training, health, and other human capital would also affect the earning differentials between education classes. The effect of education itself could be isolated only if the amount of other human capital as well as ability were held constant. This section considers the effect on the apparent gain from education of adjusting for the relation between education and other capital.

The empirical evidence available here is even more limited than that available on differential ability. More than half of all high-school graduates in the sample from three states compiled by the Commission on Human Resources had some technical school training.[31] Although the Commission presented no evidence on this, such training is probably less common among college graduates. Other studies indicate that on-the-job training and expenditures on health, adult education, and migration are greater among college than among high-school graduates.[32] College graduates seem, therefore, also to invest more in other human capital than high-school graduates, although the opposite is clearly true for some kinds of capital, and a fuller treatment would have to incorporate these differences.

However, the net effect of even a positive correlation between education and other human capital on the earning differentials between college and high-school graduates may contradict the reader's intuitive presumption. Consider college graduates who received on-the-job training from, say, the age of 24 to 30; after that age they would earn more than if they had had no training, but they would earn less during the training period because training costs are then paid by a reduction in reported earnings (see Chapter 11, section 1). Training, and more generally all other investments in human capital, would therefore increase observed differentials at older ages and reduce them at

[31] See Wolfle and Smith, *Journal of Higher Education*, April 1956.

[32] Indirect estimates of the relation between on-the-job training and education were prepared by J. Mincer in "On-the-Job Training: Costs, Returns, and Some Implications," *Investment in Human Beings*, NBER Special Conference 15, Supplement to *Journal of Political Economy*, October 1962, Tables 1 and 2. Evidence on the relation between health and education is cited by S. Mushkin (*ibid.*, p. 131). Evidence indicating a strong positive correlation between adult education and formal education can be found in J. W. C. Johnstone, *Volunteers for Learning*, National Opinion Research Center, Report No. 89, Chicago, 1963. Tabulations from the 1950 Census indicate that more educated persons have higher migration rates (computed by June Cohn for the Labor Workshop at Columbia University).

younger ones, the net effect depending on the relation between deducted costs and returns from the investments, and the rate at which future earnings are discounted. Deducted costs may be less than actual costs because the direct costs of health, migration, and certain other investments are not deducted from earnings. This consideration is not too important, since foregone earnings are usually the main component of costs.

If the rate of return on other investments was the same as the rate on education, the rate computed from the education-earnings differentials would equal the true rate on education, and thus would *not* be biased. This rate would make the present value of the gross differentials equal to zero because it makes both the present value of the differentials due to other investments and those due to education equal to zero. If the rates of return on other investments were smaller than the rate on education, the rate computed from the gross differentials would also be smaller than the true rate on education, still assuming that education and other investments were positively correlated. For the rate on education would make the present value of the differentials due to other investments negative. Conversely, if the rates of return on other investments were larger, the rate computed from the gross differentials would also be larger than the true rate on education. The opposite conclusions hold if education and other investments are negatively correlated.

Thus, rates of return computed from gross differentials could be seriously biased estimates of the true rates on education only if the rates of return on education and other human capital differed considerably. Moreover, even if education and other capital were very positively correlated, computed rates could *understate* the true rates on education, and would do so whenever the latter were greater than the rates on other capital.

A priori arguments are ambiguous and do not indicate whether rates on education are higher or lower than those on other human capital.[33] Unfortunately, moreover, few empirical studies of rates of return on other human capital have been made; some preliminary estimates by Mincer suggest higher rates on college education than on other capital.[34] If so, rates computed from differentials between college and high-school graduates would be biased *downward* if the former also invested more in other kinds of human capital.

[33] See Mincer in *Investment in Human Beings*, pp. 63–64.
[34] *Ibid.*, pp. 64–65.

3. Rates of Return to Other College Persons

White male college graduates make up less than a third of all persons who receive some college education; about half of those starting college drop out before completing four years, and more than a third of all graduates are female or nonwhite.[35] Therefore, the average gain from college would be seriously overstated by estimates based on white male graduates if, as is often alleged, they gain much more from college than dropouts, nonwhites, or females.[36] This section discusses the gains to dropouts, nonwhites, women, and rural persons, and concludes that they are smaller than the gain to urban white male graduates, although the differences are less than is often alleged. Also considered are discrimination against nonwhites, the relationship between marriage and education, some historical testimony on the importance of foregone earnings, and an indirect method of assessing relative gains.

College Dropouts

If college graduates were more successful than the average person with some college, concentration on graduates alone would overestimate the gain to all persons with some college, in the same way that concentration on long-running plays alone would overestimate the gain from investing in Broadway plays. As already mentioned, a bias here could be important since almost half of all males starting college drop out before completing four years, and some writers have implied that the gain to dropouts is substantially less than that to graduates. To

[35] See R. E. Ibbert, *Retention and Withdrawal of College Students*, U.S. Office of Education, Washington, 1957, Table 8, p. 18, and *Population Characteristics, Educational Attainment: March 1957*, Current Population Reports of the Bureau of the Census, Series P-20, No. 77, Tables B-C, 2, 3, and 4.

[36] "Furthermore, the statistics show that graduation at any level yields a bonus amounting to about twice the investment realized by the average man who starts a given type of school (elementary school, high school or college) but does not finish" (Glick and Miller, *American Sociological Review*, June 1956, p. 309). Or, as H. Houthakker said, "Hence it may not be true, in the case of higher learning, that it is better to have loved and lost than never to have loved at all" ("Education and Income," *Review of Economics and Statistics*, February 1959, p. 27). For views on the relative gains to Negroes and women, see Morgan and David, *Quarterly Journal of Economics*, August 1963, p. 437, and H. Schaffer, "Investment in Human Capital: Comment," *American Economic Review*, December 1961, pp. 1031–1032.

take an extreme case, if the rate of return to dropouts were zero,[37] the rate to all persons entering college would be about two-thirds that of graduates,[38] or less than 10 per cent for the 1939 and 1949 cohorts. Consequently, if college were of no economic value to dropouts, the rate of return on college would begin to seem rather modest.

Dropouts earn relatively little more than high-school graduates, which explains why their gain is quite often considered small. In 1949, for example, the average income of white male high-school graduates aged 35 to 44 was about 60 per cent of that of college graduates and 80 per cent of that of college dropouts the same age. However, one must not forget that costs are also less for dropouts since they average only about two years of college,[39] while graduates average about four and a half years. The rate of return would be lower for dropouts only if the difference in returns were greater than the difference in costs. Depending on the adjustment for growth and taxation, the private

[37] This is not the most extreme case, since the rate could be negative, and would be if the sum of returns were less than the sum of costs.

[38] The rate of return can be approximated by $r = k/C$, where r is the rate for the cohort, k the average return per period, and C is the sum of costs (see Chapter III, section 1). Let the subscripts g, d, and a refer to graduates, dropouts, and all entrants, respectively; since by assumption $r_d = 0$, then $k_d = 0$. If dropouts attend college for two years on the average and are equal in number to graduates, then

$$k_a = 0 + k_g, \quad \text{and} \quad C_a = C_g + \tfrac{2}{3}C_g = \tfrac{13}{9}C_g.$$

Therefore,

$$r_a = k_a/C_a = k_g/\tfrac{13}{9}C_g = \tfrac{9}{13}k_g/C_g = \tfrac{9}{13}r_g.$$

[39] The Office of Education followed a sample of students entering college in 1950 for four years (see *Retention and Withdrawal of College Students*). Persons dropping out of their institution of first registration averaged about 1.4 years of school (estimated from *ibid.*, Table 8). This underestimates the average college education of the Census category 13–15 years of schooling for two major reasons. The Office of Education study refers only to dropouts from the institution of first registration, yet 17 per cent of these were known to have transferred to other institutions before the fall of 1954 (*ibid.*, p. 81). In addition, the Census category is supposed to include only persons who have completed at least thirteen years and less than sixteen years of schooling. If persons dropping out before *completing* the first year were omitted from the special study, dropouts would average about 2.4 years of college. Some other biases, however, work in the opposite direction. For example, transferees eventually completing college presumably average more years of college initially than other dropouts. More importantly, the special study only includes colleges offering a four-year program. Graduates and dropouts from junior colleges have no more than two years of schooling from their institution of first registration. I decided to split the difference between 1.4 and 2.4 and take two years as the average college education of persons reporting 13–15 years of schooling.

Some supporting evidence is given in a tabulation of the number of persons completing 13, 14, or 15 years of schooling. If all persons in this category dropped out just after completing a year, the 13–15 category would average about 13.8 years; if they dropped out in midyear, they would average 14.3 (computed from *Population Characteristics, Educational Attainment: March 1957*, Table D).

rate of return would range from 8.2 to 11.6 per cent for the 1939 cohort of urban, native white, male college dropouts and from 6.6 to 8.7 per cent for the 1949 cohort of white male dropouts, with the best single estimates at about 9.5 and 8 per cent, respectively (see the discussion in section 1 above). These rates are far from negligible and indicate that some college is by no means an economic waste. At the same time they are decidedly less than the corresponding rates of 14.5 and 13 per cent for college graduates, and suggest that the difference in costs does not completely offset the difference in returns. According to these estimates the last two and a half years of college would yield about 18 per cent,[40] while the rate for all entrants would be some 1.5 percentage points less than that for graduates.[41]

As already mentioned, these unadjusted rates of return to college dropouts may not be biased upward since dropouts have about the same IQ and class rank as high-school graduates (see Table 5), and while dropouts come from higher socioeconomic backgrounds, they have demonstrated a certain lack of persistence. This view receives support from the study by Morgan and David referred to in section 2 above: differentials between college dropouts and high-school graduates after adjustment for a measure of socioeconomic background and other variables are almost as large as or perhaps even larger than the unadjusted differentials.[42] On the other hand, the discussion in section 2 indicates that the crude rates of return to college graduates are somewhat biased upward. One set of adjustments for class rank and IQ reduced the gain from college to a typical high-school graduate from about 13.5 per cent to slightly under 11.5 per cent, which eliminates almost half of the crude difference in rates between graduates and dropouts. Adjustments performed by Morgan and David also reduce but do not eliminate the differential between graduates and dropouts.[43] Consequently, much, although not all, of the very large

[40] The rate on all four and a half years is approximately a simple average of those for each year (see Chapter III, section 1, especially footnote 7).

[41] Using the notation and assumptions of footnote 38 gives $C_a = C_g + C_d$, $k_a = k_g + k_d$, and, therefore,

$$r_a = \frac{k_a}{C_a} = \frac{k_g + k_d}{C_g + C_d} = r_g \frac{C_g}{C_g + C_d} + r_d \frac{C_d}{C_g + C_d} = wr_g + (1 - w)r_d.$$

If $r_g = 13.5$ per cent and $r_d = 8.5$ per cent, r_a is approximately 12 per cent since w is about 9/13.

[42] The ratio of unadjusted to adjusted differentials is 87 per cent at ages 18 to 34 and 113 per cent at older ages (see *Quarterly Journal of Economics*, August 1963, Table III). Moreover, in some ways the unadjusted differentials were overadjusted (see my comments on their study in section 2).

[43] *Ibid.* They were reduced by 65 and 14 per cent at ages 18 to 34 and 35 to 74, respectively.

apparent bonus for college graduation would seem to result from the differential ability of college graduates. The remaining bonus may indicate some "increasing returns" to the third, fourth, and later years of college study.

Nonwhites

Absolute income differentials between college and high-school graduates are substantially less for nonwhites than for whites: for example, in 1939 nonwhite male college graduates aged 35 to 44 earned about $700 more in the South and $500 more in the North than nonwhite high-school graduates, about one-third of the $2000 differential for whites. Nonwhites do not necessarily gain less from college, however, since both their direct and indirect college costs are much lower. Indirect costs are lower because nonwhite high-school graduates earn less than white graduates, and direct costs are lower because nonwhites attend cheaper (and "lower-quality") colleges.[44] Again the relevant question is whether the difference in costs is sufficient to compensate for the difference in returns. Depending on the adjustments for taxes and growth, the 1939 cohort of urban, nonwhite, male college graduates received rates of return ranging from 10.6 to 14 per cent in the South, and from 6.6 to 10 per cent in the North, with the best estimates at about 12.3 and 8.3 per cent.[45] Both are less than the 14.5 per cent rate for urban native white males.[46] This evidence indicates that nonwhite male high-school graduates have less incentive than white graduates, but not much less, to go to college.

[44] Most nonwhites are Negroes and about 85 per cent of Negro college students in 1947 were enrolled in Negro colleges (see *Higher Education for American Democracy*, A Report of the President's Commission on Higher Education, Washington, 1947, Vol. II, p. 31). In 1940 the average expenditure per student in Negro colleges was only about 70 per cent of that in white colleges. For white costs, see *Current Operating Expenditures and Income of Higher Education in the United States, 1930, 1940 and 1950*, Commission on Financing Higher Education, New York, 1952, Tables 58 and 3; for Negro costs, see "Statistics of Higher Education, 1939–40," *Biennial Survey of Education in the U.S., 1938–40*, Washington, 1944, Vol. II, Chapter IV, Tables 18 and 19. For some complaints about the low quality of Negro colleges, see the article by F. M. Hechinger in *The New York Times*, Sept. 22, 1963.

[45] All nonwhite graduates are assumed to go to Negro colleges, which was nearly true of nonwhites in the South and largely true of those in the North. If northern nonwhites went to white colleges, their rate of return would only be about 7.3 per cent.

[46] None of these rates have been adjusted for differential ability because the relevant data are not available for nonwhites. Their *differential* ability is probably greater than that for whites because only the more ambitious and otherwise able nonwhites can overcome their very low socioeconomic background and go on to college. If so, adjusted rates would be relatively lower for nonwhites.

One way to check such a conclusion, as well as to provide indirect evidence on rates of return when direct evidence is not available, is to look at actual behavior. Each group of high-school graduates can be said to have a curve relating the fraction going to college to the gain expected from college. Presumably these curves are positively inclined, and their location and elasticity are determined, respectively, by the average level and the dispersion around the average in ability, availability of financing, tastes, and attitudes toward risk. If two groups had identical supply curves, the gain expected by one would be larger if, and only if, the fraction going to college were also larger.

Now if white and nonwhite males had identical supply curves, the modestly higher rate of return estimated for whites would imply—if the elasticity was of medium size—that a modestly larger fraction of whites would go to college.[47] Many readers may be surprised to learn that almost as many nonwhite high-school graduates go to college as white: in 1957, about one-third of all nonwhite male high-school graduates over twenty-five had some college, while a little over two-fifths of all white male graduates did.[48] Of course, the fact that fewer nonwhites go to college cannot be considered impressive support of the evidence indicating that nonwhites gain less. For their supply curve has probably been to the left of that of whites,[49] and thus fewer nonwhites would go to college even if the gains were the same. But the relatively small difference in the fractions going to college is impressive support of the evidence indicating that the difference in gains is not very great. For *many fewer* nonwhites would go to college if their supply curve were much to the left *and* if they gained much less from college.[50]

[47] Of course, the quantity supplied would be a function of the expected real gain, not merely the monetary gain. In relating relative supplies to relative monetary gains, I am implicitly assuming that any differences in psychic gains can be ignored. See Chapter V for a further discussion of psychic gains and their relation to actual behavior.

[48] See *Population Characteristics, Educational Attainment: March 1957*, Tables 1 and 3.

[49] Nonwhites typically have less resources, and experience greater difficulty in gaining admission to certain colleges.

[50] Moreover, there is some evidence that fewer nonwhite male graduates generally go to college even when father's education and several other variables are held constant (see *School Enrollment, and Education of Young Adults and Their Fathers: October 1960*, Current Population Reports, Washington, 1961, Table 9; and *Factors Related to College Attendance of Farm and Nonfarm High School Graduates: 1960*, U.S. Bureau of the Census, Washington, 1962, Table 16). In general, nonwhites have been found to have less education even when many other factors are held constant (see M. H. David, H. Brazer, J. Morgan, and W. Cohen, *Educational Achievement—Its Causes and Effects*, Ann Arbor, 1961, Tables 1–10).

Discrimination against nonwhites.[51] It may be surprising that the rate of return to nonwhite college graduates appears lower in the North than in the South and only slightly lower than the rate of return to whites, since discrimination is clearly much greater in the South and increases in both regions with the education of nonwhites.[52] In this section, rate of return estimates are related to the analysis of discrimination, thus reconciling the findings here with my earlier work on discrimination. The main result of this reconciliation is to support the implications of the rate of return estimates; namely, discrimination against nonwhite college graduates may have been less in the South than in the North and relatively modest, especially in the South.

The market discrimination coefficient (*MDC*) between two groups has been defined as[53]

$$MDC = \frac{\pi_w}{\pi_n} - \frac{\pi_w{}^0}{\pi_n{}^0}, \tag{128}$$

where π_w and π_n are actual earnings and $\pi_w{}^0$ and $\pi_n{}^0$ are what they would be in the absence of market discrimination. If these groups were equally productive, $\pi_n{}^0 = \pi_w{}^0$, and

$$MDC = \frac{\pi_w}{\pi_n} - 1. \tag{129}$$

If several sets of these groups can be distinguished by an ordered characteristic, such as occupation, education, age, or income, the *MDC* can be said to measure average discrimination, and a marginal *MDC* measuring the additional discrimination encountered as a result of moving to a higher level can be defined in terms of the change in earnings between levels, as:

$$MDC_{ij} = \frac{\pi_w{}^j - \pi_w{}^i}{\pi_n{}^j - \pi_n{}^i} - \frac{\pi_w{}^{0j} - \pi_w{}^{0i}}{\pi_n{}^{0j} - \pi_n{}^{0i}}, \tag{130}$$

where j and i are different levels of the characteristic in question. Equal productivity between W and N would give the simpler relation

$$MDC_{ij} = \frac{\pi_w{}^j - \pi_w{}^i}{\pi_n{}^j - \pi_n{}^i} - 1. \tag{131}$$

[51] This section deviates from the main line of argument and can be skipped by persons not especially concerned with discrimination against nonwhites.

[52] See my *Economics of Discrimination*, Chicago, 1957, Chapters 7 and 8.

[53] See *ibid.*, Chapter 2.

Well-known relations between marginal and average functions imply that the marginal *MDC* would be above, equal to, or less than the average *MDC* depending on whether the latter was increasing, constant, or decreasing.

TABLE 7

Average and Marginal Market Discrimination against Nonwhites for Various Age and Education Classes, by Region, 1939

	Average MDC by Years of Education			*Marginal MDC by Years of Education*		*Adjusted Marginal MDC by Years of Education*	
Age	*16+* (*1*)	*12* (*2*)	*7 & 8* (*3*)	*16+* (*4*)	*12* (*5*)	*16+* (*6*)	*12* (*7*)
				SOUTH			
25–29	.82	1.08	.69	.35	4.35	.37	3.57
30–34	1.27	1.23	.89	1.33	2.97	.43	2.65
35–44	1.50	1.68	1.12	1.23	4.49	.61	3.66
45–54	1.57	1.62	1.27	1.49	2.85	.69	2.57
55–64	1.56	1.55	1.08	1.62	3.61	.72	3.07
				NORTH			
25–29	.47	.50	.37	.37	1.23	.71	1.52
30–34	.78	.72	.45	.89	2.82	.99	2.61
35–44	1.17	.96	.64	1.75	2.70	1.44	2.53
45–54	1.37	.85	.73	3.92	1.17	2.58	1.48
55–64	1.23	.70	.63	5.11	.86	3.20	1.27

Source: Basic data from *16th Census of the United States: 1940, Population, Educational Attainment by Economic Characteristics and Marital Status*, Bureau of the Census, Washington, 1947, Tables 29, 31, 33, 35. Zeman (in his unpublished Ph.D. dissertation, "A Quantitative Analysis of White–Non-White Income Differentials") computed mean incomes from these data for whites and nonwhites by region, age, and education class. The average, marginal, and adjusted *MDC*s are all defined and discussed in the text.

Columns 1, 2, and 3 of Table 7 measure the average and columns 4 and 5 the marginal *MDC* at various ages in 1939 between white and nonwhite elementary, high-school, and college graduates, assuming that nonwhites and whites are really equally productive. In the North both marginals tend to be above the corresponding averages, while in the South they are somewhat below at the college level.

These marginal *MDC*s measure the ratio of the returns from addi-

tional schooling to whites and nonwhites,[54] and are greater, equal to, or less than zero as the return to whites is greater, equal to, or less than that to nonwhites. The previous discussion indicated that the return from college is lower for nonwhites partly because both their costs and their incremental benefits are lower. To the extent that returns differ because of cost differences, they do not measure market discrimination alone; rather they measure the combined effects of market and nonmarket discrimination.

The more general definition in equation (130) tries to correct for these influences by subtracting from the observed differentials those differences that would exist were there no marginal market discrimination. The empirical implementation of such a correction is always difficult;[55] a simple approach is to assume that if there were no marginal market discrimination, whites and nonwhites would receive the same rate of return on their additional schooling. Their respective costs are taken as given, although in reality they may differ because of nonmarket discrimination and other factors.[56] With this approach, the marginal *MDC* becomes proportional to the percentage difference in rates of return, the factor of proportionality being the ratio of costs.[57] So the rate of return and market discrimination approaches

[54] According to equation (131), the marginal *MDC* at a particular age would be

$$MDC_{ij} = \frac{\pi_{wj} - \pi_{wi}}{\pi_{nj} - \pi_{ni}} - 1,$$

$$= \frac{\Delta\pi_{wij}}{\Delta\pi_{nij}} - 1,$$

where π_{wi} and π_{wj} are the incomes of whites at two schooling levels, and π_{ni} and π_{nj} are the incomes of nonwhites. But $\Delta\pi_{wij}$ and $\Delta\pi_{nij}$ are simply the returns to whites and nonwhites, respectively, from going from the i^{th} to the j^{th} school level.

[55] See *ibid.*, pp. 93–95 and 130–131.

[56] One such factor is market discrimination at lower age and educational levels since the lower foregone earnings of nonwhite college students results partly from market discrimination against nonwhite elementary and high-school graduates. Consequently, this approach implies that market discrimination at lower levels reduces the earnings that nonwhite college graduates would receive even if there were no discrimination against nonwhite *college graduates*. This implication may or may not be considered reasonable, but for my purposes it is not necessary to use a more sophisticated method.

[57] The marginal discrimination coefficient can be written as

$$MDC_{ij} = \frac{\Delta\pi_w}{\Delta\pi_n} - \frac{\Delta\pi_w{}^0}{\Delta\pi_n{}^0}.$$

To a first approximation

$$\Delta\pi_w = r_w C_w \quad \text{and} \quad \Delta\pi_n = r_n C_n,$$

come more or less to the same thing when a distinction is drawn between marginal and average discrimination.

Consequently, since the rate of return to nonwhite college graduates is much higher in the South than in the North, the adjusted marginal *MDC* should be much lower there.[58] Moreover, the rather small difference between the rate of return to whites and to southern nonwhites implies that the adjusted *MDC* in the South should be quite small, certainly much smaller than the average and the unadjusted marginal *MDC*s against college graduates. Column 6 (of Table 7), which assumes that nonwhite college graduates would have received the same rate of return as white graduates were there no market discrimination against them, supports these implications: the adjusted marginal *MDC* is only about .6 in the South compared to 1.4 in the North and to average and unadjusted marginal *MDC*s in the South of 1.5 and 1.2, respectively.

Market discrimination against southern nonwhite college graduates is apparently relatively small, even though market discrimination against nonwhites is generally quite large in the South.[59] One possible line of explanation emphasizes that nonwhite college graduates partially avoid white discrimination by catering to their own market, where the discrimination against them is presumably less severe. A relatively large fraction of nonwhite college graduates were, indeed, in occupations that cater to a segregated market: in 1940 about 50 per cent of nonwhite graduates were doctors, dentists, clergymen,

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where r_w and r_n are the rates of return and C_w and C_n are the costs of moving from the i^{th} to the j^{th} educational level. By assumption,

$$\Delta\pi_w^0 = rC_w \quad \text{and} \quad \Delta\pi_n^0 = rC_n.$$

Therefore, the first equation in the footnote can be written as

$$MDC_{ij} = \frac{r_w C_w}{r_n C_n} - \frac{rC_w}{rC_n}$$

$$= \frac{C_w}{C_n}\left(\frac{r_w - r_n}{r_n}\right).$$

58 This conclusion presupposes that the rate of return to white college graduates is also not much higher in the South. The available evidence suggests that the rate of return to whites is somewhat higher in the South.

59 The 1950 Census also shows larger earning differentials between college and high-school nonwhites in the South than North (see C. A. Anderson, "Regional and Racial Differences in Relations between Income and Education," *The School Review*, January 1955, pp. 38–46). The 1950 Census data, however, did not separate rural from urban persons, and many more southern than northern nonwhites live in rural areas, especially at lower educational levels. Perhaps this explains why the 1950 Census, unlike the 1940 Census, also shows larger differentials in the South between nonwhites with high-school and elementary school educations.

teachers, or lawyers, while only 35 per cent of white graduates were.[60] The opportunities to cater to a segregated market were probably more available to southern graduates since the nonwhite market is both larger (relative to supply) and more segregated there.[61] Fewer opportunities to avoid discrimination are available to nonwhite high-school graduates: the same fraction of whites and nonwhites were in occupations not catering to segregated markets.[62] This would explain why column 7 of Table 7, which presents adjusted marginal *MDC*s against nonwhite high-school graduates, shows substantially greater discrimination in the South.

Let me emphasize, however, in concluding this section, that a much more intensive examination of the evidence, especially of that collected in the 1960 Census, is necessary before these findings can be fully accepted.

Women

Absolute income differentials are much smaller for female than male college graduates, but the rate of return may not be smaller because direct costs are somewhat lower and opportunity costs are much lower for women. One reason why a smaller money—not necessarily real—rate of return would be expected is the much lower labor force participation of women. In fact, the difference in costs does not seem to compensate fully for the difference in returns. Both Mincer and Renshaw find that the rate of return received by white women college graduates is several percentage points lower than that received by white men.[63] Actual behavior is consistent with the evidence on gains: about 30 per cent of women high-school graduates go to college, while 40 per cent of the men do.[64] Although this difference can also be explained by other factors, such as a prejudice against higher education for women, the fact that a larger fraction of nonwhite than

[60] See *1940 Census of Population, Occupational Characteristics* (sample statistics), Bureau of the Census, Washington, 1943, Table 3.

[61] For a discussion of evidence on income distributions that led to the same interpretation, see M. Friedman, *A Theory of the Consumption Function*, Princeton for NBER, 1957, pp. 84–85.

[62] For example, in 1940 about 37 per cent of both white and nonwhite high-school graduates were craftsmen, operators, or laborers, occupational groups that do not sell their services to segregated markets. (See *1940 Census of Population, Occupational Characteristics*, Table 3.)

[63] See Mincer in *Investment in Human Beings*, p. 68, and Renshaw in *Review of Economics and Statistics*, August 1960.

[64] See *Population Characteristics, Educational Attainment: March 1957*, Tables B and 2, for data referring to 1950 and 1957.

white women high-school graduates have gone to college[65] cannot be so easily explained by these factors since nonwhite women have less resources, are discriminated against even more by certain colleges, etc. Yet nonwhite women might have gained more from college if only because they participate more in the labor force. Indeed, Renshaw does find a high rate of return to nonwhite women college graduates.[66]

Many women drop out of college after marriage, and college women are more likely to marry educated and wealthy men. These well-known facts suggest that women go to college partly to increase the probability of marrying a more desirable man. If the marriage factor were important, the gain to women from additional schooling should be determined by *family* earnings classified by the wife's education rather than by personal earnings so classified,[67] and the full money gain to women may be much higher than previous estimates have indicated.

Table 8 presents data from a survey of subscribers to Consumers' Union that classified family income by the education of both spouses.[68] Women college graduates tend to have slightly higher family incomes than men with the same education, while women high-school graduates have much higher family incomes than men high-school graduates.[69] Thus differentials between the family incomes of college and high-school graduates are also much less for women than men. Accordingly, even when the gain from a more lucrative marriage is included, the money rate of return from college seems less for women, a conclusion that is, as already mentioned, consistent with actual behavior. Table 8 suggests that the gain from postgraduate study is also less for women, a

[65] *Ibid.*, Tables C, 2, and 3.

[66] *Review of Economics and Statistics*, August 1960, p. 322.

[67] Presumably the differential in their wives' earnings should be included as part of the gain to men from additional schooling, but double counting would occur if the earnings of both spouses were fully included as gains of both. Probably the ideal way to avoid duplication would be to define returns as

$$R_m = W_1 r_{mm} + W_2 r_{mw}$$
$$R_w = W_1' r_{wm} + W_2' r_{ww},$$

where R is the full return, the W's are weights, r_{mm} is the differential earnings of men from additional schooling, r_{mw} is the differential earnings of their wives, and r_{wm} and r_{ww} are similar concepts applied to women (very likely $W_1 > W_2$ and $W_2' > W_1'$).

[68] The survey was conducted by the Workshop in Expectational Economics at Columbia University and I am indebted to Albert Hart and Marshall Kolin for making the data available to me.

[69] Presumably the main reason is that they tend to marry men of higher education, although the high-school figures may also be biased because the relatively small number of male subscribers who never completed high school are included with the male high-school graduates.

result consistent with crude evidence on actual behavior,[70] but perhaps not with evidence restricted to unmarried college graduates.

TABLE 8

Family Incomes of Married Men and Women in 1960, by Education and Years after First Job (dollars)

Years after First Job	*Years of Education and Sex*					
	16+ Men (1)	*16+ Women* (2)	*16 Men* (3)	*16 Women* (4)	*12 Men* (5)	*12 Women* (6)
7–8	10,140	9,718	8,310	9,190	5,850	7,980
9–10	10,210	10,784	8,920	9,380	6,630	7,410
19–20	11,330	11,018	10,000	10,980	7,470	9,200

Source: May 1960 survey of subscribers to Consumers' Union sponsored by the Workshop in Expectational Economics of Columbia University.

Rural Persons

Income differentials between college and high-school graduates are apparently much less for rural than for urban persons,[71] but indirect costs are also less[72] because rural high-school graduates earn less than urban ones. They may also be less because rural persons earn relatively more while in college, for they can help with farm chores during summer vacations.[73]

[70] See *Population Characteristics, Educational Attainment: March 1957*, Table D.

[71] See *Income of Families and Persons in the United States* for 1956 and 1958, Current Population Report, Series P-60, Nos. 27 and 33, U.S. Bureau of the Census, Washington, 1958 and 1960, and other calculations from Census data included in an unpublished manuscript by Z. Griliches.

[72] It is not clear whether direct costs are less. On the one hand, tuition is less because rural persons more frequently attend heavily subsidized state colleges; on the other hand, transportation and other direct costs are higher because they attend colleges further from their homes than urban persons do.

[73] In October 1960 students aged 18 to 24 worked a slightly smaller number of hours relative to nonstudents of the same age when employed in agriculture than when employed elsewhere. (See *The Employment of Students, October 1960*, Bureau of Labor Statistics, Special Labor Force Report, No. 16, Washington, 1961, Tables E and F.) I suspect, however, that summer employment is much greater for rural college students, so that on balance they forego relatively less earnings. This has certainly been true at the high-school level, where rural students work more than

Instead of trying to determine directly whether the differences in returns exceed those in costs, the evidence provided by actual behavior is utilized. A much smaller fraction of the graduates of rural than of urban high schools go to college; indeed, a smaller fraction of rural males go than urban females or urban males with fathers who are manual or service workers. Relatively few rural graduates go to college even when family income, IQ, type of high-school curriculum, scholastic standing, and several other variables are held constant.[74] The difference in returns is apparently more important than the difference in costs.

4. Variation in Rates of Return

The private rate of return to cohorts of white male college graduates seems considerable even after adjustment for differential ability. Rates to cohorts of college dropouts, nonwhites, women, and rural persons, although smaller, are also far from negligible. Evidence such as this has encouraged various public bodies and interested citizens to exhort young persons in their own interest to go to college and to succeed in graduating. Now results for cohorts can be applied to individuals only if different members of a cohort are affected more or less to the same extent; if, however, they are affected very differently, they may well be justified in largely ignoring the cohort results.

The gain from college has been shown to vary by sex, race, urban or rural, and graduate or dropout status, and (see section 2) even within a given demographic group, according to ability. This section indicates that the variation in gain within a group like white male college graduates is much greater than can even be explained by the variation in ability alone. So great is it that an individual can be only loosely

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urban ones during the school year (see, e.g., *ibid.*), and even attend school many fewer days.

Indeed, the much heralded increase in the length of the school year since the turn of the century has been entirely the result of the spread to rural areas of patterns already established sixty years ago in New York, Chicago, and other large cities (see E. Denison "The Residual Factor and Economic Growth," paper prepared for a May 1963 meeting of the OECD). One might even claim that the development of trimester and quarterly systems at many colleges and a few high schools is a reaction to the secular growth of foregone earnings and the spread of urbanization. Since urban communities do not experience the summer increase in demand for labor that rural ones do, the summer holiday is an anachronism and an expensive luxury in a high-wage urban community.

74 See *Factors Related to College Attendance of Farm and Nonfarm High School Graduates: 1960*, Tables 11, 12, 15, and 16.

guided by the gain of his cohort, and has to place considerable weight on his own situation and hope for the best.

TABLE 9

Coefficients of Variation in After-Tax Income of White Males, by Age and Years of Education, 1939 and 1949

	1949		*1939*	
Age	*12* (*1*)	*16+* (*2*)	*12* (*3*)	*16+* (*4*)
25–29	.44	.75	.55	.73
30–34	.47	.59	.69	.75
35–44	.60	.75	.79	.66
45–54	.83	1.01	.75	.66
55–64	1.05	.92	.77	.68

Source: Computed from *1940 Census of Population, Education,* and *1950 Census of Population, Education.* The 1949 incomes apply to all white males, while those for 1939 apply only to urban native white males. The adjustments for personal income taxes are described in Appendix A.

Table 9 presents, for several age classes and high-school and college graduates, coefficients of variation in the incomes of native white urban males in 1939 and white males in 1949.[75] The variation is certainly not negligible since these coefficients average more than two-thirds. There is some tendency, especially in 1949, for the variation to increase with age,[76] while there is little systematic difference by educational level.

These coefficients do not fully measure the variation in income among all members of a given educational cohort because only the

[75] Similar measures for 1949 can be found in H. Houthakker, *Review of Economics and Statistics,* February 1959, Table 1. I shall only consider the dispersion among white males, although it would be of some interest to compare different races and sexes.

[76] Some of the increase is spurious because the two youngest age classes cover only five years while the three oldest cover ten. The variation is generally larger, the larger the number of years covered by an age class because earnings tend either to rise or decline systematically with age.

The 16+ category in 1939 failed to show a rise with age almost certainly because independent professionals were not included in these calculations. Their dispersion definitely rises with age and they would be more important at older ages. The inclusion of property income in 1949 and the exclusion of self-employed persons in 1939 explains why the variation seems to be lower in 1939, especially at older ages and among college graduates.

incomes of survivors are included and, therefore, the dispersion in length of life is ignored. The latter is still considerable, although it has declined over time along with the decline in mortality.[77]

Columns 1 and 2 of Table 10 present coefficients of variation in survivorship from eighteen to selected ages.[78] These are larger at older ages and smaller in 1949 than in 1939.

A more complete measure of variation within a cohort would take account of both survivorship and the incomes of survivors, and such measures are shown in the rest of Table 10.[79] At younger ages the full variation is not much greater than that in incomes alone because the probability of surviving to these ages is close to unity. But at older

[77] In the United States the expected lifespan (ignoring years after age sixty-five) of eighteen-year-old males increased from thirty-two years in 1900 to thirty-eight years in 1950, while the coefficient of variation changed even more, from 0.74 to 0.54. (For 1900, see *United States Life Tables 1890, 1901, 1910 and 1901–1910*, Bureau of the Census, Washington, 1921, Table 3. For 1950, see *United States Life Tables 1949–51*, Vital Statistics-Special Reports, National Office of Vital Statistics, Vol. 41, No. 1, Washington 1954, Table 2.)

A revealing comment on the dispersion in length of life in the past was made by Adam Smith: "The work which he learns to perform . . . will replace to him the whole expense of his education, with at least the ordinary profits of any equally valuable capital. It must do this too in a reasonable time, *regard being had to the very uncertain duration of human life, in the same manner as to the more certain duration of the machine*" (*Wealth of Nations*, New York, 1937, Book I, Chapter X, my italics).

[78] If a random variable S_x takes on the value of 1 when a person survives from age eighteen to age x, and the value of 0 when he dies before x, the square of the coefficient of variation of S_x equals

$$G(S_x) = \frac{1 - P_x}{P_x},$$

where P_x is the probability of surviving to age x and, therefore, also the expected value of S_x. Columns 1 and 2 list different values of $[G(S_x)]^{\frac{1}{2}}$.

[79] The problem is to find the coefficient of variation in $S_x I_x$, where S_x is defined in the previous footnote and I_x measures incomes at age x. Since S_x takes on the value of 1 for survivors and 0 for others, the relevant income variable is that of survivors. If I_x is so defined, the variance of SI is

$$\begin{aligned}\sigma^2(SI) &= (1 - P)P^2(EI)^2 + P[EI^2 - 2P(EI)^2 + P^2(EI)^2] \\ &= P[EI^2 - P(EI)^2] \\ &= P[\sigma^2(I) + (EI)^2(1 - P)] \\ &= P\sigma^2(I) + \sigma^2(S)(EI)^2\end{aligned}$$

and

$$G(SI) = \frac{\sigma^2(SI)}{(ESI)^2} = \frac{G(I)}{P} + G(S).$$

These equations also follow as special cases of theorems on the variation of products if the distribution of I defined over all values of S was independent of the distribution of S. (See L. A. Goodman, "On the Exact Variance of Products," *Journal of the American Statistical Association*, December 1960.) In other words, the distribution of I among survivors would be the same as the full distribution of I.

TABLE 10

Coefficients of Variation in Mortality and Cohort Incomes for College and High School Graduates, by Age, 1939 and 1949

Age	*Coefficient of Variation in Mortality*		*Coefficient of Variation in Income by Years of Education*			
			1939		*1949*	
	1939 (1)	*1949* (2)	*12* (3)	*16+* (4)	*12* (5)	*16+* (6)
25–29	.14	.12	.57	.75	.46	.77
30–34	.18	.16	.72	.79	.50	.62
35–44	.26	.22	.85	.72	.65	.79
45–54	.39	.34	.89	.81	.94	1.12
55–64	.61	.55	1.09	1.01	1.31	1.18

Source: Columns 1 and 2 computed from *State and Regional Life Tables 1939–41*, and *United States Life Tables 1949–51*; columns 3 through 6 computed from columns 1 and 2 and from Table 8, using the formula in footnote 80.

ages it is significantly greater—more than a third greater at ages 55 to 64—because the variation in survivorship becomes quite large then. The substantial increase in the variation of survivorship with age makes the full variation increase rather sharply with age, generally being more than 50 per cent larger at ages 55 to 64 than at 25 to 29. There is still no appreciable relation with education, although the variation among college graduates is usually greater in 1949.

Although these adjusted coefficients are interesting and relevant, they would be the appropriate measures of the variation within cohorts only if different educational levels were mutually exclusive alternatives, as working in New York or San Francisco are. A college graduate is, however, usually also a high-school and elementary-school graduate. Therefore, a person deciding whether to go to college wants to know how much *additional* variation is caused by going, in the same way that nonwhites want to know how much additional discrimination results from moving to a higher educational level. In other words, the additional or marginal variation caused by a college education should be measured, just as the marginal discrimination against nonwhite college graduates was measured (see section 3).

If the gain from college is measured by the rate of return, marginal variation should be measured by the variation in this rate. According

to the analysis in Chapter III, if returns were the same in each year and lasted forever, the rate of return could be written as

$$r = k/C,$$

where r is the rate, k is the return in any year, and C is the cost of college. The variation in r would be larger, the larger the variation in k and C and the smaller the correlation between them.[80] If returns were not the same in different years, the simple formula in equation (38) would not hold, but it is apparent that the variation in r would be smaller, the smaller the serial correlation among returns.

Therefore, the variation in the rate of return among members of a given cohort depends on four basic parameters: the variation in costs, the variation in returns, the correlation between returns and costs, and the correlation between returns in different periods.[81] Unfortunately, little is known about some of these, so the effect of college on income variation cannot yet be fully ascertained. But I shall try to determine what the effect appears to be by briefly discussing what is known about each parameter.

Least is known about the correlation between costs and returns. The significant differences between the incomes of graduates from Negro and other cheaper colleges and those from Ivy League and other expensive ones[82] certainly indicate that the correlation is positive. The fact, however, that graduates of the same college receive very different incomes suggests that although the correlation may be positive and significant, it is also very far from perfect.[83]

The variation in costs among college graduates is apparently con-

[80] If σ^2 stands for the variance and E for the expected value,

$$\sigma^2(r) = E^2(k)\sigma^2\left(\frac{1}{C}\right) + E^2\left(\frac{1}{C}\right)\sigma^2(k) + \sigma(k)\sigma\left(\frac{1}{C}\right),$$

when the correlation between k and $\frac{1}{C}$ equals zero. A more complicated formula applies when it differs from zero (see *ibid.*).

[81] Both these correlations are special cases of the more general correlation between income differentials (either costs or returns) in different periods.

[82] Some evidence on the incomes of graduates from different schools can be found in E. Havemann and P. S. West, *They Went to College*, New York, 1952. Their book is based on the survey of incomes in 1947 by *Time* magazine. As mentioned in section 2, Hunt ("Income Determinants for College Graduates") used the same data and found a positive relation between the incomes of alumni and estimates of the amount spent on students by different colleges.

[83] Thus the partial regression coefficient that Hunt finds between incomes and expenditures, although sizable, is just barely statistically significant.

siderable. For in 1940 the coefficient of variation in expenditures per student in one state alone—New York—was .9 among private colleges and .3 among public ones,[84] and the variation in the whole country was surely greater. Moreover, I have already shown that foregone earnings can vary widely, certainly among demographic groups, and probably also within groups, because of differences in ability, local labor market conditions, and so forth.

There is no direct evidence on the serial correlation of returns to college graduates, but it probably can be closely approximated by a weighted average of the serial correlation between the incomes of college graduates and of high-school graduates.[85] The correlation be-

[84] Computed from "Statistics of Higher Education, 1939–40," Chapter IV, Tables 18 and 19.

[85] If $k_1 = Y_{c1} - Y_{h1}$ and $k_0 = Y_{c0} - Y_{h0}$ were the returns in years 1 and 0, respectively, the correlation coefficient between returns would be

$$R(k_0, k_1) = \frac{\text{Cov}\ (k_0, k_1)}{\sigma(k_0)\sigma(k_1)}.$$

If Y_c and Y_h were always uncorrelated, and if small y's represent deviations from means,

$$\begin{aligned}\text{Cov}\ (k_0, k_1) &= E(y_{c1} - y_{h1})(y_{c0} - y_{h0}) \\ &= E(y_{c1}y_{c0}) + E(y_{h1}y_{h0}),\end{aligned}$$

and

$$\sigma^2(k) = E(y_c - y_h)^2 = \sigma^2(y_c) + \sigma^2(y_h).$$

Then

$$R(k_0, k_1) = \frac{E(y_{c1}, y_{c0}) + E(y_{h1}, y_{h0})}{[\sigma^2(y_{c1}) + \sigma^2(y_{h1})][\sigma^2(y_{c0}) + \sigma^2(y_{h0})]}.$$

If it is assumed for simplicity that

$$\sigma^2(y_{c1}) = \sigma^2(y_{c0}) = \sigma^2(y_c), \quad \text{and} \quad \sigma^2(y_{h1}) = \sigma^2(y_{h0}) = \sigma^2(y_h),$$

then

$$\begin{aligned}R(k_0, k_1) &= R(y_{c1}, y_{c0})\frac{\sigma^2(y_c)}{\sigma^2(y_c) + \sigma^2(y_h)} + R(y_{h1}, y_{h0})\frac{\sigma^2(y_h)}{\sigma^2(y_c) + \sigma^2(y_h)} \\ &= wR(y_{c1}, y_{c0}) + (1 - w)R(y_{h1}, y_{h0}).\end{aligned}$$

The major assumption is that Y_c and Y_h are uncorrelated, but the result would not be very different if they were positively correlated. For the correlation between returns would be greater, equal to, or less than that given in the last equation as

$$R(y_{ct'}, y_{ht'}) \gtreqless R(y_{ct}, y_{ht})R(y_{ct}, y_{ct'}),$$

where the left term is the average correlation coefficient between the incomes of college graduates in year t and otherwise equivalent high-school graduates in t'; the first term on the right is the average correlation coefficient between their incomes in the same year; and the second term on the right is the average correlation coefficient between the incomes in t and t' of persons with the same education. If the forces determining $R(Y_{ct'}, Y_{ht})$ were independent of those determining $R(y_{ct}, y_{ct'})$, as is probably approximately true, equality would hold, and the correlation between returns would be given by the equation above.

tween the adjacent incomes of persons with a given education is very high and even those between incomes separated by a few years remain high.[86] While the correlation between incomes separated by many years is probably much less, one explanation may be that these intermingle a positive correlation between returns in different periods and a positive correlation between returns and costs.[87]

Remaining is the variation in returns during any period, which depends on the variation in the earnings of college graduates (given for white males in Table 10), the variation in their earnings if they had not gone on to college, and the correlation between these two. The variation in the earnings of college graduates if they had not gone to college may differ from the actual variation among high-school graduates because of the differences in "ability" between college and high-school graduates discussed in section 2. As pointed out there, however, three important measures of "ability"—rank in class, IQ, and father's occupation—although they have significant effects on the earnings of college graduates, apparently have little effect on those of high-school graduates. If they are representative of the effects of other differences, the actual variation in high-school earnings could be used to estimate the hypothetical variation among college graduates. The same argument suggests that the correlation between these earnings would not be very high, for the factors making earnings high among college graduates are apparently quite different from those making them high among high-school graduates.

Table 11 presents estimates of the coefficient of variation in the return to college graduates. These assume that the variation in the income of college graduates if they had not gone to college can be measured by the actual variation among high-school graduates. Two estimates are presented at each age class: one assuming no correlation between the incomes of college and high-school graduates aside from a common mortality experience,[88] and the other assuming a perfect

[86] Some correlations for independent professionals, whose earnings are presumably less stable than those of the typical college graduate, averaged about .85 between adjacent earnings and .75 between those separated by two years (see Friedman, *Consumption Function*, Table 18; for other evidence, see I. Kravis, *The Structure of Income*, Philadelphia, 1962, Chapter VIII).

[87] See Mincer in *Investment in Human Beings*, p. 53, especially footnote 8.

[88] The correlation coefficient between the incomes of college and high-school graduates at a particular age x equals

$$r = \frac{E[(S_{cx}I_{cx} - ES_{cx}EI_{cx})(S_{hx}I_{hx} - ES_{hx}EI_{hx})]}{E(S_{cx}I_{cx})E(S_{hx}I_{hx})\sqrt{G(S_{cx}I_{cx})G(S_{hx}I_{hx})}},$$

where S, G, etc., are defined in previous footnotes. Now if $S_c = S_h = S_s$ and if I_c and

TABLE 11

Coefficients of Variation in the Returns to College Graduates, by Age, 1939 and 1949[a]

Age	*1939* (*1*)	*1949* (*2*)
25–29	3.35	8.73
	1.28	3.57
30–34	2.74	1.72
	.91	.94
35–44	2.56	2.00
	.47	1.00
45–54	2.59	2.55
	.65	1.33
55–64	3.09	2.98
	.84	.99

Source: Table 9 and the formula

$$\sigma^2(R) = \sigma^2(c) + \sigma^2(h) - 2r_{ch}\sigma(c)\sigma(h),$$

where R is the return, and c and h represent the earnings of college and high-school graduates, and σ^2 represents a variance.

[a] Top entries assume that incomes of college and high-school graduates are uncorrelated aside from mortality experience; bottom entries assume that they are perfectly correlated.

correlation. As already mentioned, the true correlation is a good deal closer to the first. The table indicates a very substantial coefficient of variation in the returns to college graduates, probably averaging over 2.0. As opposed to the variation in income (see Table 10), there is no systematic tendency for this variation to increase with age.

Let us now bring together the discussion of these four parameters. The coefficient of variation in returns is very large, probably averag-

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I_h are uncorrelated, then

$$E[(SI_c - ESEI_c)(SI_hEI_h)] = ES^2EI_cEI_h - (ES)^2EI_cEI_h = EI_cEI_h\sigma^2(S),$$

and therefore

$$r_{min} = \frac{G(S)}{\sqrt{G(SI_c)G(SI_h)}}.$$

ing more than 2.0. The variation in costs is also large, although not as large as that in returns, and costs and returns are positively correlated. Consequently, the variation in returns per dollar of cost, equation (5), is probably lower, but not very much lower, than that in returns alone. Since returns are not perfectly correlated over time, the variation in the rate of return is less than that in returns per dollar of cost. The difference is not great, however, since the correlation of returns over time is apparently very high. The net effect would seem to be a rather high variation in the rate of return; the coefficient of variation is almost certainly higher than one and possibly a good deal higher.

One way to illustrate the magnitude of the variation is to point out that although a cohort of white males might receive a private rate of return of 12 per cent, many members will receive more than 25 or less than 0 per cent.[89] The existence of many low and even negative returns has been presumed by others from the wide overlapping of the distributions of the earning of college and high-school graduates.

Another way is to compare it with the variation in the rate of return to physical capital. Many persons have stressed that a dynamic competitive economy produces considerable variation in the gain from capital and some rough estimates by Stigler confirm this: the coefficient of variation in the returns per dollar of capital invested in a group of smaller corporate manufacturing firms was somewhere between one and two.[90] About the same variation was found in the return per dollar invested in a college education. But since the stability of the returns to education is apparently much greater,[91] the variation in rates of return on college education is very likely greater than that on manufacturing capital in smaller corporate firms.

A final question to be discussed is: How much of this large variation in the gain from a college education can be anticipated due to known differences in ability, environment, etc., and, therefore, should not be considered part of the *ex ante* risk? I have already argued that differences in gain due to race, sex, or urban-rural status should not be considered risk since they are, at least in part, anticipated and thus

[89] If rates of return were normally distributed and if the coefficient of variation equaled one, about one-third of the members would receive rates either above 24 or below 0 per cent.

[90] See G. J. Stigler, *Capital and Rates of Return in Manufacturing Industries*, Princeton for NBER, 1963, p. 63, footnote 14.

[91] Stigler found a correlation of only .7 between the adjacent, and much smaller correlations between the nonadjacent, average returns per dollar of capital in different manufacturing industries (*ibid.*, Table 18). Presumably the ranking among firms is even less stable.

affect behavior. One factor making it easy to anticipate differences even within a demographic group is the unusual stability of returns. On the other hand, differences in known measures of ability, such as IQ and grades, are small,[92] and have a rather small effect on earning (see section 2). Moreover, investors in education are much younger than investors in business capital; college students are generally in their early twenties, and are certainly not yet fully aware of their talents.

An important factor increasing the difficulty of anticipating the gain from college is that it is collected over a very long time. While business investments are often said to pay off within five or ten years, the payoff from college takes much longer: the unadjusted rate of return to the 1949 cohort of white male graduates is about 13 per cent; yet ten years after graduation it would still be negative and after a full fifteen years only about 6 per cent. A long payoff period increases risk along with low correlations between returns by reducing the value of information available when investing. Incidentally, the long payoff period increases the advantage of an education that is useful in many kinds of future economic environments. If "liberal" education were identified with such flexible education, as well it may be, there would be an important economic argument for liberal education, as well as arguments based on intellectual and cultural considerations.

[92] For example, the coefficient of variation in the IQ of college graduates is only 13 per cent (computed from Wolfle, *America's Resources*, Table G-2).