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1. Introduction and Summary of Findings

Many important changes have occurred in higher education in the United States since 1900. At the turn of the century very few people finished high school, but most of those who did, attended college. For example, only about 7 percent of the population born around 1880, but 70 percent of all high school graduates, entered college. After World War I there was a big increase in the number of students attending high school but a sharp decrease in the fraction of high school graduates attending college.[1] However, after World War II the fraction of high school graduates attending college increased, until by 1970 about 50 percent of the eligible age group and 60 percent of all high school graduates attended college.[2]

The organization of higher education also changed greatly. For example, many four-year colleges changed their status to universities, numerous two-year colleges were founded, and normal schools became teachers colleges, which in turn expanded into standard four-year colleges. As the number of institutions of higher learning has increased, attempts have been made (for example, in California) to integrate community colleges, four-year colleges, and universities into statewide systems of education.[3] Partly in response to the increased demand for higher education at a reasonable cost, state-operated institutions have expanded to become more important in terms of the number of students and the quality of faculties.

The introduction of new courses and a change in emphasis between general and technical education has also shifted the focus of higher education. In part, these changes reflect the formation of new disciplines and the growth in knowledge. However, they also reflect shifts in

[1] In part this represented a shift in educational policy toward supplying more education at all levels (Finch, 1946; Folger & Nam, 1967).

[2] These estimates are derived from the methods given in Appendix B. See also Folger and Nam (1967).

[3] See Jencks and Riesman (1968).

the composition of the student population. In 1900, a large fraction of college graduates became medical doctors, lawyers, theologians, or engineers. Since 1900, there has been a marked shift in careers toward business and other professions.[4]

There were several basic causes for these changes. First, there was the need for the educational system to adapt to new conditions in society. These new conditions included the increased demand of the wealthy for education as a consumption or status good; a shift in the occupational mix towards scientific skills; and the belief that education was required to obtain a good job. Second, there was the desire to make as much high-quality education as possible available to all those who could benefit from it.

Change comes no more easily to the academic world than elsewhere. Any alteration in graduation requirements or course offerings raises substantial opposition and debate. Expansion in the size of the university has caused controversy paralleling that of the expansion of high school education.[5] Much of the debate has concerned the need for quality in education and the question of who would or should benefit from higher education.[6]

One particular argument against the expansion of higher and secondary school education has perhaps been raised more than any other. The basis of the argument is that the courses given at most higher-level institutions of learning are oriented towards training people to use mental facilities and certain learning tools to solve various abstract and practical problems. But to be able to acquire the tools and to learn how to solve problems, a person must have a certain threshold level of mental ability or IQ.[7] Therefore, if many students below this threshold level were admitted to institutions of higher learning, the resources they used would be wasted. In addition, the admission of unqualified students in large numbers might interfere with the instruction of those who would benefit from the education.[8]

An argument in favor of expansion points to the "loss in talent" that occurs when many students above the required threshold level cannot

[4]See Wolfle (1954).

[5]See, for example, the statement by the president of Harvard in Finch (1946).

[6]It is generally assumed that benefits from education can be measured by the additional future income attributable to education, by the consumption value, and by any external factors such as the value to society of a better functioning democracy.

[7]It is sometimes maintained that the threshold level is at least one-half a standard deviation above the population mean.

[8]This could occur with a class of a very wide range of abilities, if teachers pitched their instructional level too low.

enter college and therefore never have the chance to develop their talents. Some proponents of expansion indicate that excessive heterogeneity in ability levels could be avoided if expansion took the form of added variety in the types of educational institutions.

These viewpoints involve contradictory assertions that can only be resolved by reference to empirical evidence. For higher education in the United States, the facts under dispute are: (1) Did the expansion in college enrollment since 1900 lead to a decline in the average mental ability of college students? (2) Did the expansion lead to a reduction in the loss of talent? (3) At what minimum level of mental ability do individuals (or perhaps society) cease to receive any benefits from education? While these questions are important, very little research has been undertaken to answer them.[9]

Our main interest in this paper is to examine the first two questions by determining the relationship, in various samples spanning the twentieth century, between the percent of high school graduates who enter college and their mental ability at the time of college entrance.[10] The samples used, which are often referred to by name, are drawn from the Project Talent Study and the studies done by Barker, Berdie, Berdie and Hood, Benson, Little, O'Brien, Phearman, Proctor, Wolfle and Smith, and Yerkes. Each of these studies present information on the number of high school graduates entering college by IQ or aptitude test score. To make the tests comparable, we converted the scores to a percentile basis.

The information obtained in answering these two questions can also be used in analyzing other important economic problems. For example, for many purposes in economics it is important to know if the average ability level of persons with various amounts of education has remained constant over age groups. Thus, we may wish to determine how income varies over time for people with a given amount of education. If the average ability level of those with a given amount of education has remained constant over time, we can answer this question by studying income differences for various age groups with a given educational level, as available, say, in the 1960 census. But if the average ability level within an education level is not constant over age groups, the income differences in the census occur because of both age and ability differences.

In addition, the coefficient of education in an equation relating education to mental ability plays an important role in determining the

[9] Partial exceptions are Berdie, et al. (1962) and Darley (1962).

[10] In a recently completed study addressed to the third question, we found that rates of return to higher education do not vary with ability for those in the top half of the ability distribution, except perhaps for people with graduate education and very high ability. See Taubman and Wales (1972).

economic returns to education. It can be shown that when returns to education are estimated using data that do not include a mental-ability variable (such as the census data), the estimated effect of education on income will be biased upward if ability and education are positively related.[11] Further, if this relationship has changed over time, then the bias will change accordingly.

Subject to some qualifications, as given below, our major conclusions are as follows:

1 As shown in Figure 1 the average ability level of high school graduates who entered college ($\bar{A}_c$) ranges from the 53rd to the 63rd percentile (measured upward from zero) for the period 1925 to 1961. Although in the 1930s there was a reduction in the percentage of students entering college, Figure 1 indicates that there was an increase in the average quality of college students compared with the 1920s. On the other hand, the postwar boom in higher education resulted in still higher quality college students than in the 1930s and substantially higher quality students than in the 1920s. The average quality level has increased because initially only about 60 percent of the most able students went to college, while, as shown below, the growth in the fraction entering college is concentrated in the high-ability groups. There is also evidence in Darley (1962) that existing schools have increased the quality of their students while new colleges and community colleges have been started to meet the needs of the less able. Thus the more able students may be receiving a better education now.

2 There has been a significant reduction in the loss of talent since 1920. The loss of talent can be measured by the fraction of high school graduates who enter college at various ability levels. The selected values of ability, measured as percentiles (ranging upward from zero), are 25, 50, 75, and 90. At the 90th and 75th percentiles there has been a substantial increase over time in the percent entering college. At the

[11] If the true equation is

(1) $Y = \alpha A + \beta S + u$

where Y is income, A is innate ability, S is educational attainment as measured by highest grade completed, u is a random error term that is independent of A and S, and α and β are parameters to be estimated, then the estimation (by least squares) of the equation $Y = cS$, will yield a coefficient c, with expected value given by:

(2) $E(c) = \beta + k\alpha$

where k is the coefficient from the (least squares) regression,

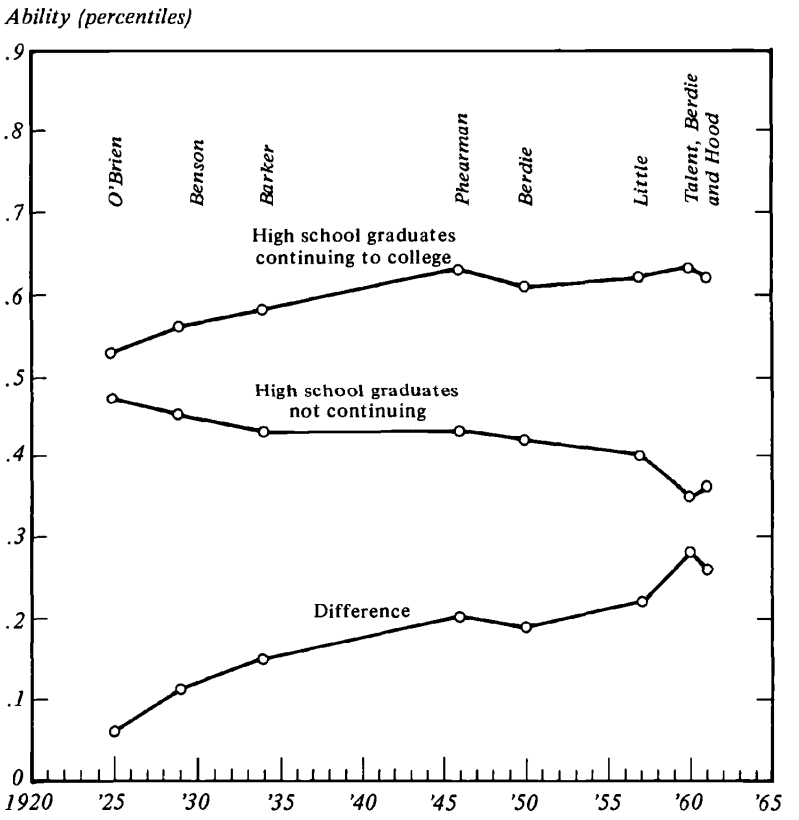
(3) $A = kS$

Thus, as long as ability is positively related to income ($\alpha > 0$), and as long as educational attainment and ability are positively related ($k > 0$), then the estimate of c in (2) exceeds β, which, from equation (1), represents the true impact of variations in S on Y.

On the other hand, if we have estimates of the ability-education relationship for various time periods, and if this relationship has changed for various cohorts, it is possible to obtain separate estimates of the effects of education and ability on income in a single cross-section that includes the various cohorts.

Thus, equation (2) expresses the estimated education coefficient in terms of income differential due to education, B, the income differential due to ability, α, and the increase in ability associated with educational changes, k. Since we can obtain an estimate of k, equation (2) has only two unknowns. If another estimate of equation (2) can be obtained in a cohort with a different k, then in principle the two equations can be solved for estimates of both α and B.

FIGURE 1 Average ability levels over time, adjusted



50th percentile the 1960 values are slightly higher than those for the 1920s and the values during the 1930s and 1940s are substantially lower. At the 25th percentile the fraction of high school graduates entering college appears to have fallen during the 1930s and 1940s, but by the 1960s was back to the 1920 level. On the basis of this evidence, we conclude that the substantial increase in the fraction of high school graduates entering college since the 1920s occurred primarily at the 75th and 90th ability percentiles.[12]

It should be realized that these results are subject to a number of qualifications, of which the following are among the most important. Many of our samples are statewide rather than nationwide, and some of the states may be atypical. This difficulty is discussed in more detail on

[12]The data (for males) prior to World War I, however, yield a picture similar to that of the 1950s and 1960s. Thus, the big loss of talent at that time occurred prior to high school graduation.

page 43. In addition, the samples use different ability tests that had to be converted to a common basis. Our results, which are based on IQ and aptitude tests, only reflect the mental abilities measured by these tests and not all types of mental ability. Finally, we are assuming that the average ability level of high school seniors in the population has remained constant over time. Although there is some evidence in Berdie, et al. (1962) that this is true, it has not been completely verified.

We turn now to a consideration of the measures of mental ability and education that we used in the analysis. This is followed by a discussion of the major conceptual and statistical problems inherent in the study, our conclusions, and then a detailed presentation of our estimate of the ability-education relationship for each sample.