370-76

INSTITUTE FOR RESEARCH ON POVERTY DISCUSSION PAPERS

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A paper presented in the "Educational Attainments and the Labor Market: Reciprocal Effects" session of the Meetings of the American Sociological Association in New York City, August 1976.

This research is supported by Grant #SOC75 - 20409 from the National Science Foundation; from the National Institutes of Health Grant #HD - 07682; and funds granted to the Institute for Research on Poverty at the University of Wisconsin-Madison by the Department of Health, Education, and Welfare pursuant to the Economic Opportunity Act of 1964. The Center for Demography and Ecology, which is supported by Population Research Center Grant (5P01-HD05876), provided computer services. Some of the data used in this paper is derived from the Occupational Change in a Generation II Survey, which was supported by National Science Foundation Grant (GI - 31604X). D. L. Featherman and R. M. Hauser, principal investigators of that grant, kindly provided access to those data. Discussion of the subject of this paper with R. M. Hauser has been most helpful. All errors of omission or commission are, of course, the sole responsibility of the authors.

The authors of this paper come to the issue of the relationship between educational attainment and the labor market from a rather practical set of concerns. About a year ago, we were asked by our University to look into its methods for estimating future enrollment. The University's traditional method for estimation is based on the application of constant, or slightly rising, cohort rates of attendance applied to the numbers of children in successive birth cohorts. In its most recent report to the Board of Regents, however, our University included, in addition to traditional projections, a projection adapted from Professor Dresch's work [Dresch, 1975]. That projection is based on a model of reciprocal effects between returns to education and numbers of persons attaining a given educational level. The results suggest that college attendance will decline very dramatically in the future.

As one might expect, this projection engendered considerable interest amongst the Regents. They have apparently become accomodated to a future of short rations due to the decline in the birth rate. But the new projections suggest a near disaster, one for which planning should begin promptly. But effecting plans appropriate to the scale of such enrollment declines is a serious matter. Such policies would themselves constitute a disaster if the predicted declines were not forthcoming. Apparently it is out of some such concern that we were asked to look into the matter.

This paper, then, is an outgrowth of our attempts to wrestle with the task of deciding what factors should go into a scheme for making college enrollment projections. We make no claim to having devised a final and appropriate estimating scheme. What we have done is investigate the relative importance of some of the factors which might be included in such a scheme.

For the purposes of this paper, the question we try to deal with is not the form of reciprocal relationships between educational attainment and market conditions nor the presumed declines in relative wages paid to the more highly edu-

cated. Rather our question is how important such mechanisms, and such facts, are to the future of college enrollments as compared to other contemporary social changes.

Two such social changes seem particularly important. On the one hand is the rising educational attainment of the parents of future potential college attenders. On the other hand is the fact that declines in fertility go hand in hand with declines in average family size.

1. Increasing Educational Attainment in Cohorts of Parents

Research on intergenerational social mobility demonstrates that one of the most powerful predictors of an individual's educational attainment is the educational attainment of his parents. Our colleagues, R. M. Hauser and D. L. Featherman [1976] have recently shown that the structural coefficients for son's education on father's have not changed appreciably in this century. Further, it is clear that the educational attainment of cohorts of parents will continue to rise for some time. This trend applied to constant structural coefficients yields, of course, projected increases in the educational attainment of birth cohorts.

The finding of constant structural coefficients over birth cohorts, then, suggests that the aspirations parents have about, and their willingness to pay for, the advantage of additional education for their children is associated with the parents' own educational level.

What are these advantages that people seem to foresee for their children? When asked in sample surveys, two-thirds of the population indicate that training for a job is the primary reason for sending children to college. When tabulated by respondent's own educational level, however, responses show a good deal of variability. Between 70 and 75 percent of people with less than college education cite economic reasons for college attendance. The figure drops to

50 to 55 percent for people with education through four years of college, and declines to between 30 to 35 percent for people with more than four years of college. The reason, which competes with the economic one, pertains to understanding the world and understanding one's self.

The rising educational level of the parents of future potential college attenders, then, may augur for two trends in college attendance. First, the proportion of birth cohorts attending college is likely to rise as their parents' educational level rises. Second, the mix of reasons why parents encourage and support their children in attendance is likely to shift from a predominance of economic motives to ones an economist might describe as a set of tastes for having liberally educated children.

2. Lower Birth Rates Mean Smaller Average Family Sizes

Certainly the most important effect on future college enrollments is simply the decline in the numbers of people in succeeding birth cohorts, which is a result of the decline in birth rates. David Goldberg [1974] has observed, however, that concomitant with the decline in birth rates is a decline in eventual family size and this decline may have something of a countervailing influence on college attendance. As people have fewer children, Goldberg argues, they are less likely to have several children who are simultaneously of college age. Thus, as birth rates decline, fewer families are in the situation of trying to support several children in college at once. Goldberg argues this countervailing factor may be fairly important in future college enrollments in Michigan.

3. Where These Trends Fit in a Projection Model

In addition to the expected relative wage advantage of college attenders, then, the above discussion suggests that size of birth cohorts, education of

parents, and number of siblings are important factors in the projection model. In any behavioral model in which causal order is determined by the life course of the potential attender, the latter variables are clearly prior to the former one. The size of one's birth cohort, the education of one's parents, and the number of competing sibs is determined within a few years of one's birth. One's expectation of the relative wage advantage of college attendance is surely subsequent to these factors. Thus, a projection model that includes the "background" factors but excludes relative wage advantage is a reduced form of the more complete model. Estimates of past enrollments derived from the reduced form, therefore, provide a way to assess the independent contribution to enrollment of "disturbances" influencing relative wages. Thus, at least we will be able to evaluate the importance of these several factors in producing the historical shift in enrollment.

4. Data Analysis

We begin our data analysis by varifying our understanding of the effect of changing education of parents and changing sib size on college attendance.

We began by creating a table from the Occupational Change in a Generation II Survey, which tabulated respondent males jointly by their mother's education, their parity, their birth year and whether they attended college or not. (The OCG II Survey was conducted in March of 1973 as supplement to the Current Population Survey.) In this table, we chose to use mother's education rather than father's and parity of respondent rather than number of siblings born within, say, four years of the respondent's birth, because the chosen variables exist reliably on the revised birth record and can be tabulated from vital records for years since 1969. Hence, these variables offer the possibility for use in routine projections.

Our first task was to see if the Hauser-Featherman [1976] finding of structural

coefficients for son's education on father's, which are constant over birth cohorts, could be replicated when using mother's education to predict college attendance rather than years of schooling completed. We also wanted to know how parity of respondent behaved. Does this variable interact with maternal education in predicting attendance? Does it also, whether alone or in interaction with maternal education, show constant effects for birth cohorts? To answer these questions, we investigated a number of log-linear models [Goodman, 1971; Bishop, Finberg, and Holland, 1975]. In our initial model we assumed there might be an interaction of parity and maternal education with college attendance as well as interactions between college attendance and cohort, parity and cohort, and maternal education and cohort. This model assumes parity by education effects on attendance, which are constant over birth cohorts.

Row 1 of Table 1 presents the Chi-square tests for the fit of this model to the data. Chi-square is less than the degrees of freedom. Thus, this model fits rather well.

Since it is possible for the addition of higher-order interactions to significantly decrease an already low Chi-square in this procedure, we tested--but do not present--models including each of the remaining three-way interactions, i.e., attendance, parity, cohort; parity, education, cohort; and attendance, education and cohort. None of these more complex models significantly diminishes the value of Chi-square. Thus, our initial model is sufficiently complex.

We then investigated whether or not a simpler model would suffice. We began by dividing the three-way interaction between attendance, parity and maternal education into its component two-way interactions. This model is concomitant to a logit analysis [Goodman, 1975]. Test values for this model are given in row 2 of Table 1. Row 3 presents the test for the difference in Chi-square. It is not significant; thus, we prefer the simpler model.

Table 1

Chi-square tests for selected log-linear models of college attendance on maternal education, parity and birth cohorts; males 25 - 64 in 1973.

Model Number or Models Compared	Marginals fitted† or Interaction tested	Dependent Variable: Attendance v.s. Non-attendance	
		Degrees of Freedom	χ^2
1	(1,2,3)(1,4)(2,4)(3,4)	1,589	1,343
2	(1,2)(1,3)(2,3)(1,4)(2,4)(3,4)	1,691	1,469
2 v.s. 1	Tests (1,2,3) v.s. (1,2)(1,3)(2,3)	102	126
3	(1,3)(2,3)(1,4)(2,4)(3,4)	1,697	1,670
4	(1,2)(2,3)(1,4)(2,4)(3,4)	1,708	3,656*
5	(1,2)(1,3)(1,4)(2,4)(3,4)	1,793	2,512*
6	(1,2)(1,3)(2,3)(2,4)(3,4)	1,698	1,538
7	(1,2)(1,3)(2,3)(1,4)(3,4)	1,733	1,550
8	(1,2)(1,3)(2,3)(1,4)(2,4)	1,810	3,080*
2 v.s. 3	Tests (1,2)	6	201*
2 v.s. 4	Tests (1,3)	17	2,187*
2 v.s. 5	Tests (2,3)	102	1,043*
2 v.s. 6	Tests (1,4)	7	69*
2 v.s. 7	Tests (2,4)	42	81*
2 v.s. 8	Tests (3,4)	119	1,611*

SOURCE: Occupational change in a Generation II Survey.

NOTE: The effective number of observations is 17,921. The number of usable observations in the O.C.G. II Sample is 23,895. These observations are weighted differentially to account for sampling stratification and deflated by .75 as an adjustment for the differential efficiency of the cluster sampling plan used in the C.P.S. as opposed to simple random sampling.

† Dimensions are numbered as follows: 1. college attendance; 2. number of older siblings coded 0, 1, 2, 3, 4, 5, 6+; 3. maternal education coded 0 - 16 in single years and 17+; 4. age of respondent coded 25 - 29, 30 - 34, 35 - 39, 40 - 44, 45 - 49, 50 - 54, 55 - 59, 60 - 65.

*Significant at the .01 level.

As further attempts at simplification of the model, we investigated a series of models, each of which drops one of the six two-way interactions. They are presented in rows 4 through 9 (Table 1) and their impact on χ^2 is tested in rows 10 through 15. In each instance there exists a significant difference in the value of χ^2. Thus, initial tables are best accounted for by the fact that the odds of college attendance are conditioned separately on parity, maternal education and cohort, while these three "independent" variables are themselves bivariately associated. Thus, parity and maternal education influence college attendance separately from cohort, while some of the observed gross change in college attendance over cohorts is attributable to the fact that the distribution of maternal education and parity have changed with time.

How can we assess the impact of secular changes in college attendance independently of changes in parity and maternal education--secular changes, which may in part be due to changes in the demand for college-trained personnel? One way is to reconsider the model, which includes all bivariate interactions except those between attendance and cohort (Model 6 of Table 1). Using this "reduced form" model, we can generate expected proportions attending college from a model that excludes direct effects from cohort to attendance. Table 2 compares the expected proportion attending in each cohort under this model with the actual proportion attending. Seventy percent of the increase in the proportion of a birth cohort attending college is explicable in terms of cohort changes in parity and maternal education. Only 30 percent of the increase is due to those effects that are associated with cohort and independent of parity and maternal education. Some of these effects may relate to changes in the demand for college-trained personnel. Others, no doubt, relate to the general upward trend in real income experienced by the parents of respondents. Whatever their source, the impact on college attendance of these secular trends has, in the past, been a good deal less than the effect of our two socio-demographic variables. It seems

Table 2

Actual and expected† reporting of birth cohorts attending college by birth cohort.

Source	Age in March 1973							
	25 - 29	30 - 34	35 - 39	40 - 44	45 - 49	50 - 54	55 - 59	60 - 65
Actual	.43	.40	.38	.34	.30	.28	.22	.20
Expected	.41	.39	.34	.33	.30	.28	.26	.25

Source: Occupational Change in a Generation II Survey.

†Expected proportions attending are computed from Model 6 of Table 1.

not unreasonable, therefore, to inquire into the effect that future changes in these variables may have on gross rates of college attendance. We can make such a projection on the basis of the parity and maternal-education-specific rates of attendance implicit in our model since we have shown these structural parameters to be cohort-invariant. The construction of such a projection is not to deny that the distribution of those variables, which operate through cohort parameters may change their distribution so dramatically as to counter-balance the effects operating via parity and maternal education. Such a projection will, however, indicate the amount of effect that such secular changes must overwhelm to be controlling. Further, our analysis suggests that such changes must be of a wholly different degree from those experienced in this century in order to dominate.

5. An Illustrative Projection

How can one use the preceding analysis for projection purposes? We believe the following procedure is appropriate. From our final model (Model 2 of Table 1) we estimate the expected odds for college attendance by maternal education and cohort for the most recent cohort--roughly that of 1945. These odds incorporate the cohort-invariant effects of education and parity and fix the cohort effect to that of the most recent group for which data is available. We then transform odds to probabilities and use the latter as a constant rate matrix for mapping the maternal education by parity distribution of subsequent birth cohorts into college attendance figures. Table 3 presents the rate matrix so generated.

Where does one get information on the parity by maternal education distributions for recently born birth cohorts? From 1969, as previously noted, such tables can be made from vital records. Because we are interested in a rather

Table 3

Rates of college attendance by parity and maternal education used for projection.

Maternal education	Number of older siblings				
	0	1	2	3	4+
0 - 4	.180	.161	.138	.111	.099
5 - 8	.274	.249	.215	.175	.153
9 - 11	.382	.348	.307	.254	.229
12	.546	.514	.468	.407	.373
13 - 15	.771	.746	.709	.655	.623
16+	.834	.814	.872	.741	.708

Source: Expected values from Model 2 of Table 1 for OCG respondents 25-29 in 1973.

longer series than can be thus acquired we have done something rather different. From the Public Use Samples of the 1960 and the 1970 Censuses of Population, it is possible to use data on own children in the household to construct a table for each birth cohort that tabulates the number of children by age, education of the mother, and parity. For children less than age 15 at the time of the census, this method of accumulating the desired information has shown itself to be reasonably accurate [Rindfuss, 1976; Rindfuss and Sweet, forthcoming].

Table 4 presents projections resulting from these data for birth cohorts from 1945 to 1969. Columns one and two present attendance rates with the figures in column one being derived from the 1970 Census and those in column two from the 1960 Census. Recall that our rate matrix pertains only to males and thus these projections are for male attendance only. Recall also that the rate matrix pertains to ever attending college rather than college entrance at the normal age. This estimating-projection technique shows that the force of changes in the maternal education and parity distributions are such as to increase college attendance of cohorts by 8 percentage points from the cohort of 1945 to that of 1969. When translated into numbers of male attenders, this projection suggests a rise in attendance to the cohort of 1960 (people who might be expected to enroll in 1978) with a subsequent decline. The projection suggests that the numbers will decline to the cohort of 1969 (people who might be expected to enroll in 1987), by which time they will have returned to the levels of the birth cohorts of the early 1950s (people who might have enrolled in the late 1960s or early 1970s).

Over all, then, our illustrative projection suggests that the decline in enrollment due to the decline in birth rates may be cushioned by increases in the proportion of a birth cohort attending college due to rising parental education and declining parity. How much of that cushion will be destroyed due to declining

Table 4

Projected proportions and number of male college attenders by birth cohort.

Birth Cohort	Year Age 18	Proportion Attending		Number Attending	
		From 1970 Census	From 1960 Census	From 1970 Census (in thousands)	From 1960 Census
1969	1987	.49		789.85	
1968	1986	.48		760.80	
1967	1985	.48		756.50	
1966	1984	.47		769.35	
1965	1983	.46		804.55	
1964	1982	.46		845.80	
1963	1981	.45		874.40	
1962	1980	.45		880.85	
1961	1979	.45		891.50	
1960	1978	.45		895.40	
1959	1977	.45	.43	901.15	871.45
1958	1976	.45	.43	883.50	868.75
1957	1975	.45	.43	889.65	863.50
1956	1974	.44	.43	859.90	840.95
1955	1973	.44	.43	838.70	819.65
1954	1972		.43		824.65
1953	1971		.43		787.25
1952	1970		.43		774.60
1951	1969		.43		735.85
1950	1968		.42		700.25
1949	1967		.42		702.75
1948	1966		.42		696.40
1947	1965		.42		734.75
1946	1964		.41		631.95
1945	1963		.40		506.85

relative wages of college attenders operating through changing cohort parameters is not clear. Cohort parameters rise rather substantially and consistently over the range in our sample, yet, as previously observed, they generate a minority of the experienced change in enrollment rates. Further, it is not clear what fraction of the variability of these cohort parameters is due to change in relative wages.

6. What Does It All Mean?

We interpret the results of our analysis to mean that there are some fairly substantial contemporary socio-demographic trends that influence educational attainment and are rather separate from changes in the relative wages of the more highly educated. In the past these socio-demographic changes have accounted for the majority of the change in college attendance and their future change is likely to impact attendance fairly considerably. It is not at all clear that the downward pressure, which might be exerted on these rates by a decline in the relative wages, will overwhelm these pressures for increase. It is clear, that effective and appropriate methods of projecting future attendance rates must include both socio-demographic trends impacting attendance as well as economic trends. Indeed, we suspect that in a larger sense, it is reasonable to imagine that educational attainment is jointly caused by variables traditionally in the economist's purview and the sociologist's domain.

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