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SOCIAL BACKGROUND COMPOSITION AND EDUCATIONAL GROWTH

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ABSTRACT

This paper examines the impact of intercohort changes in social background composition on changes in grade progression rates at selected schooling levels. It presents formal arguments that the relative and absolute effects of background composition on grade progression rates should decline over levels of schooling, and using data for white males born between 1907 and 1951, offers empirical support for these arguments. Whereas twentieth century increases in average educational attainment are primarily due to increases in grade progression rates at the elementary and secondary levels, future growth must occur through increases in transition rates beyond high school, given the near universality of high school graduation for cohorts born at midcentury. Our analysis shows that postsecondary progression rates are much less responsive to changes in family background composition than rates earlier in the schooling process. Despite intercohort changes in background composition that are increasingly favorable to educational attainment, future educational growth may be slower than past growth because compositional effects on average attainment will be through progression rates where the effects are weak.

Social Background Composition and Educational Growth

One of the most important demographic trends in twentieth century America has been the dramatic secular increase in average levels of formal educational attainment. Cohorts born during the first five years of the century completed a median of approximately 8.6 years of school (U.S. Bureau of the Census, 1960, p. 216), whereas those born between 1946 and 1950 achieved a median of 12.8 years (U.S. Bureau of the Census, 1976). There are two general sources of intercohort growth in average school attainment. One is changes in market and institutional incentives to acquire formal schooling that are experienced approximately uniformly by all individuals within a cohort, but that vary over time. Thus, for example, the relative economic advantages to persons with high levels of educational certification have persisted throughout the century; educational facilities have expanded and become more accessible to larger geographical and socioeconomic segments of the school-age population; and social legislation bearing upon child labor and compulsory school attendance has supported a trend toward universal high school attendance. The other general source of growth in attainment levels is intercohort compositional change on social background factors that affect how far individuals go in school. In particular, average levels of parental income, occupational status, and educational attainment have all increased significantly during the twentieth century, whereas family size and the proportion of the population raised on farms have declined. Given the effects of each of these factors on grades of school completed within cohorts, these changes have implied substantial intercohort increases in attainment.

Approximately one third of change in mean grades completed over cohorts of men born during the first half of the century can be ascribed to intercohort change in social background composition (Hauser and Featherman, 1976, p. 104). We can gain further insight into the respective roles of social background factors and aggregate market and institutional sources of educational growth, however, by regarding schooling as a sequence of grade progressions rather than simply as a single number of grades completed. Changes in levels of educational attainment have not occurred as a result of uniform changes in grade progression rates at each stage of the schooling process. Instead, grade progression rate increases have been substantially greater at the elementary and high school levels than during postsecondary schooling (Duncan, 1968, Table 18). In addition, the cross-sectional (intracohort) impact of social background on grade progression varies considerably over levels of schooling. The effects of parental socioeconomic characteristics on the odds of continuing from one level of schooling to the next decline sharply from the earlier to the later stages of the schooling process (Mare, 1976). This suggests that much can be learned from examining how the effects of intercohort changes in social background composition on changes in grade progression rates vary over school transitions. This paper has two overall goals: first, to see how much the trends in grade progression rates are due to compositional change in social background or, conversely, the extent to which observed trends would have occurred even had cohort background composition remained constant; and, second, to examine how the relative effects on grade progression of background compositional change and changes in market and institutional incentives independent of background composition vary across school transitions at various stages of the schooling process.

Such an analysis has important implications for understanding the historical structure and future course of educational growth in the United States. Hauser and Featherman (1976) argue that secular increases in socioeconomic attainment in both parental and filial generations and persistent socioeconomic background effects on attainment augur continued educational growth. The schooling levels of mothers of children currently in school are unprecedentedly high, suggesting that cohorts now in school will attain higher average education levels than all preceding cohorts. This argument, however, may require some qualification.

Changes in average grades of school completed over cohorts born during the first half of the twentieth century are principally the result of increases in grade progression rates at the grade and high school levels. For white males, for example, more than 90 percent of change in mean grades completed between cohorts born at the beginning of the century and at midcentury is due to change in grade progression rates for school transitions below the college level (Mare, 1977). On the other hand, for cohorts born at midcentury, proportions of persons graduating from high school approach 90 percent. Thus any significant future increases in average attainment must occur through increased grade progression above the high school graduate level. To argue that rising parental socioeconomic attainments for young cohorts implies sustained strong educational growth is to assume that the educational attainment process is well characterized by linear relationships between background and attainment that are invariant over the entire schooling process. If, on the other hand, intercohort changes in, for example, progression from high school to college, are less due to social background compositional changes than are changes in progression from 8th to 9th grade, then future educational growth may be less than a simple linear model would imply.

Winsborough and Sweet (1976) show that intercohort trends in background composition have had substantial impact on college attendance rates in cohorts born during the twentieth century. They calculate that rising maternal education levels and declining family sizes account for 70 percent of change in attendance rates, and, on this basis, forecast continued attendance rate increases. Again, however, extrapolation from the observed role of background in college attendance rate growth is only appropriate if background compositional changes affect continuation rate changes uniformly at all schooling levels through college. For white males, approximately 80 percent of change in college attendance rates is due to increases in grade progression rates at the precollege level, whereas only 20 percent is due to increases in the proportion of high school graduates going on to college (Mare, 1977, Table 5.1). Given the already high proportions of cohorts completing high school, future increases in attendance rates will rely heavily on changes in progression rates between high school and college. Extrapolation from past trends, therefore, assumes that background compositional changes induce changes in transition rates between high school and college as large as at the precollege level.

In short, the analysis of the effects of background compositional changes on grade progression rates should clarify the character of educational growth due to demographic change; that is, it will suggest whether growth is the inevitable consequence of rising parental socio-economic levels or, on the other hand, that background related increases in average attainment have historically been very large because they have been through change in continuation rates where the effects of background are uniquely strong.

An additional benefit from analyzing the role of background in aggregate grade progression rate changes is that it casts light upon the adequacy of recent econometric analyses of aggregate enrollment rates (Freeman, 1975; Dresch, 1975). The present analysis calculates and compares series of grade progression rates both unadjusted and adjusted for social background at various schooling levels. Since time series analyses of enrollment change typically use enrollment rate series not adjusted for trends in social background composition, our analysis implicitly tests the validity of this practice. To wit, if there is close correspondence between adjusted and unadjusted sequences of school continuation rates, then standard procedures are vindicated. If not, then our results cast doubt on the validity of aggregate studies of school and college attendance.

This paper discusses formally the variation over school transitions in the absolute and relative effects of social background composition on intercohort grade progression rate changes. It notes that differences among school transitions in the absolute effects of background shifts on intercohort grade progression rate changes should mirror differences among school transitions in the effects of social background at the individual level. Then it argues that there should be systematic variation over school transitions in the relative effects of social background and nonbackground factors on intercohort progression rate changes. After discussing data source, measures, and statistical methods, it presents empirical results for the white male population in regard to this argument. Finally, it discusses the implications of these results for trends in the average level of formal schooling in the population.

1. VARIATION IN THE IMPORTANCE OF SOCIAL BACKGROUND COMPOSITION

We distinguish between the <u>absolute</u> effects of intercohort shifts in average values of family background characteristics on intercohort grade progression rate changes and the <u>relative</u> effects of background and nonbackground factors on progression rate changes.

Absolute Effects of Background Composition

Consider, for each school transition, the following model of grade progression rates:

$$\lambda_{ij} = \beta_0 + \sum_k \beta_k X_{ijk} + \gamma_j \tag{1}$$

where λ_{ij} is the log odds of grade progression for the i<u>th</u> individual in the j<u>th</u> cohort, X_{ijk} is the value for the i<u>th</u> individual in the j<u>th</u> cohort on the k<u>th</u> social background variable, and the β_k and γ_j are parameters. (We employ a logistic specification because grade progression decisions are binary outcomes. This permits meaningful comparisons across equations for school transitions that have different grade progression proportions. For further justification of the specification, see Mare, 1976, 1977.) At each level of schooling the absolute change in the log odds of grade progression between the (j-1)st and the jth cohorts due to intercohort change in the mean of the kth social background variable is

$$\beta_k(\bar{X}_{jk} - \bar{X}_{(j-1)k}) \qquad (2)$$

where $\bar{X}_j$ is the mean of X_{ijk}. Thus the absolute impact of changes in average levels of social background depends upon the individual level effects β_k of each social background variable when cohort membership is taken into account. Over school transitions the effect of background changes will vary as the β_k vary. From cross-sectional analysis we know that in most instances the effects of family background decline steadily from the lowest levels of schooling to the highest. (These results are summarized in Appendix Table 1, and are discussed in detail in Mare, 1976, 1977.) Thus if the β_k do not differ substantially from the effects of background estimated without simultaneously estimating cohort effects, then they will typically decline in absolute value from the lowest schooling levels to the highest. Now (2) will, of course, also vary across levels of schooling as the $\bar{X}_{jk} - \bar{X}_{(j-1)k}$ vary. The $\bar{X}_k$, the average levels of background factors, are more favorable to grade progression at higher levels of schooling than at lower levels since individuals with values on X_k unfavorable to grade progression will be underrepresented at higher schooling levels. Thus while background effects β_k decline over schooling levels, the $\bar{X}_k$ increase. But the variation in the $\bar{X}_k$ over levels of schooling is nowhere near as great as variation in the β_k; that is, the means of the background characteristics do not increase (in absolute value) as much as the actual background effects decline (in absolute value). By implication, variation over levels of schooling in β_k will also be greater than variation in intercohort changes in average levels of background $X_{jk} - X_{(j-1)k}$. Thus even though $X_{jk} - X_{(j-1)k}$ may, in principle, be somewhat larger at higher schooling levels, the much greater declines (in absolute value) in the β_k ensure that (2) will be larger at lower schooling levels than at higher levels. Hence as a straightforward consequence of the cross-sectional effects of social background on grade progression, the absolute effects of intercohort background shifts on grade progression are stronger at the lowest school transitions. Given the cross-sectional results, this conclusion rests on no assumptions other than that social background effects estimated in the presence and absence of controls for cohort membership are similar in pattern over school transitions. Thus we present no explicit calculations in support of the conclusion beyond social background effect estimates that take cohort membership into account. We shall, however, return to its implications at the end of the paper.

Relative Effects of Background Composition

We turn next to the relative effect of background and nonbackground changes at various schooling levels on intercohort progression rate shifts. The problem of appraising variation over school transitions in the relative effects of background can best be formalized by considering its obverse; that is, the extent to which intercohort change in grade progression mirrors the variation that would have occurred in the absence of background compositional variation.

Where observed cohort grade progression rates and rates adjusted for intercohort variation in background factors coincide, background compositional changes have no impact on progression rate changes and observed rates are principally due to factors independent of background. Where, on the other hand, observed and adjusted rates differ substantially, then this difference is due to adjustment for social background.

Let λ_j be the observed average log odds of grade progression for the <u>jth</u> cohort and λ_j^* be the log odds of grade progression adjusted for social background for the <u>ith</u> cohort; that is,

$$\lambda_j^* = \beta_o + \sum_k \beta_k X_{..k} + \gamma_j \tag{3}$$

where $X_{..k}$ is the grand mean (over all cohorts) of the <u>kth</u> social background factor and the remaining notation is as in (1).

To evaluate the relative effect of social background shifts on changes in the λ_j, therefore, we focus on the correspondence, over cohorts, between the λ_j and the λ_j^*. A conceptually satisfactory way to do this is to consider, for each school transition, the linear relationship between adjusted and observed cohort log odds of grade progression, say

$$\lambda_j^* = a + b\lambda_j + e_j \tag{4}$$

where a and b are parameters and e_j is a stochastic disturbance. The intercept a is of little interest here since it is simply a function of the grand mean of the log odds of progression (over all cohorts) and of b. The slope b, however, is of central interest. It measures the average proportion of change in progression due to factors other than social background. Thus the proportion of change due to background compositional change is 1 - b.

We can see how b varies over school transitions by showing how it depends upon the parameters of models at the individual level. Consider two models of grade progression: The first is given by (1), which includes the effects of both social background and cohort membership; the second is

$$\lambda_{ij} = \mu + \delta_j \tag{5}$$

where μ is the grand mean of the log odds of grade progression and δ_j is a parameter denoting the difference between the log odds of grade progression for the jth cohort and the grand mean.

We can regard the λ_j in (1) and the δ_j in (5) as parameters corresponding to dichotomous variables denoting cohort membership. Alternatively, we can regard them as scaled variables affecting λ_{ij}, with slope coefficients equal to unity. So we can rewrite (1) and (5) as

$$\lambda_{ij} = \beta_o + \Sigma\beta_k X_{ijk} + 1\gamma_j \tag{6}$$

and

$$\lambda_{ij} = \mu + 1\delta_j \tag{7}$$

respectively. Now since

$$\lambda_j = \mu + \delta_j$$

and

$$\lambda_j^* = \beta_o + \sum_k \beta_k \bar{X}_{..k} + \gamma_j$$

we can reexpress (4) as

$$\gamma_j = a^* + b\delta_j + e_j \tag{8}$$

where

$$a^* = a + b\mu - \beta_o - \sum_k \beta_k \bar{X}_{..k}$$

and b and e_j are defined as before.

Substituting (8) into (6) we get

$$\lambda_{ij} = \beta_o^* + \sum_k \beta_k X_{ijk} + b\delta_j + e_j$$

where

$$\beta_o^* = \beta_o + a^*.$$

Now, applying the omitted variable formula to (7), we have

$$1 = b + \sum_k \beta_k \Theta_k \tag{9}$$

where the β_k are as given by (6) and the Θ_k are defined by the linear equations

$$X_{ijk} = \Theta_o + \Theta_k \delta_j + u_{ij}$$

where Θ_o is a parameter and u_{ij} is a stochastic disturbance. That is, the Θ_k are the zero order coefficients for the regressions of the social background characteristics X_{ijk} on the cohort parameters δ_j. Finally, from (9) the coefficient of the regression of the adjusted on the observed log odds of grade progression is

$$b = 1 - \sum_k \beta_k \Theta_k \ .$$

Thus to determine schooling-level variation in the relative effects of background and nonbackground factors on intercohort grade progression rate changes it suffices to consider how the quantity $\Sigma\beta_k\Theta_k$ varies over school transitions. As we have noted, the effects of social background decline steadily from the lowest schooling levels to the highest (see Appendix Table 1). Assuming that the pattern of background effects over school transitions is not materially affected by simultaneously estimating background and cohort membership effects, this implies that the β_k will decline in absolute value from earliest schooling levels to the latest. As for the Θ_k, they will typically have the same sign as their respective β_k, guaranteeing that $\beta_k\Theta_k$ will be positive for all k. Thus, for example, both the average level of father's schooling and the effect parameter for cohort membership will both increase from the earliest to the most recent cohorts; so, for father's schooling, Θ_k will be positive as will be β_k. Conversely, a factor such as average number of siblings declines over cohorts producing a negative Θ_k corresponding to the negative effect β_k of number of siblings on grade progression. Over schooling levels, it is not clear how Θ_k should vary. A reasonable pair of assumptions are that, first, changes in the

$\bar{X}_{jk}$ should be similar over schooling levels because they refer to changes in the same variable for overlapping subsets of the same populations; and second, change in the δ_j should be similar over schooling levels because at each level they reflect the secular trend in grade progression rates. These assumptions together suggest that the Θ_k will not vary substantially over schooling levels. Thus variation over schooling levels in b is driven primarily by variation in the β_k (multiplied by weights Θ_k, which ensure that all $\beta_k\Theta_k$ are positive). Since $\beta_k\Theta_k$ is positive, b will be less than unity. Thus at the earliest schooling levels, where social background exerts a particularly strong influence, b will be considerably less than one; at the higher levels of schooling, where background effects are weak, b will approach one. And, from (4), the proportion of change in λ_j due to factors other than social background will be positively associated with schooling level. Conversely, from (5), the proportion of change in grade progression due to intercohort background shift declines from the lowest to the highest schooling levels.

2. DATA AND METHODS

To examine these arguments empirically we employ data on white males from the 1973 Occupational Changes in a Generation (OCG) Survey. See Featherman and Hauser (1975) for a detailed description of the survey design. The survey was a supplement to the March 1973 Current Population Survey, which had a target population of the U.S. male civilian noninstitutional population aged 20 to 65. The data include information on the socioeconomic achievements and social background of approximately 33,500 men.

Using the OCG data we estimate the effects of social background factors and cohort membership on selected school continuation decisions. From the respondent's report of his highest grade of schooling completed we deduce his continuation decisions. In particular, we focus on whether the individual (1) completes 8th grade; (2) attends 9th grade given 8th grade completion; (3) completes 12th grade given 9th grade attendance; (4) attends 13th grade given 12th grade completion; (5) completes 16th grade given attends 13th grade; and (6) attends 17th grade given 16th grade completion. Though it is obviously possible to analyze other school transitions, these approximate entry into and completion of the principal institutional stages of the American formal school system.

The social background variables included in the analysis are father's grades of school completed, mother's grades of school completed, annual family income when the respondent was 16 years old in constant (1967) dollars, father's occupational status in units of the Duncan socioeconomic index when the respondent was 16 years old, number of ever-living siblings, a dichotomy taking the value one if the respondent did not live with both parents most of the time up to age 16 and zero otherwise, a dichotomy taking the value one if the respondent was born in the South census region and zero otherwise, and a dichotomy taking the value one if the respondent lived on a farm and zero otherwise. That each of these variables are important indicators of the social, economic, and psychological resources that affect individuals' motivations to attend school and have significant independent effects on school attainment is well established (for example, Blau and Duncan, 1967; Hauser, 1970; and Sewell and Hauser, 1975). Thus we shall not reiterate their substantive importance here. For discussion of how the effects of these variables on grade progression should vary across school transitions see Mare (1976, 1977). Suffice it to note that these factors provide a detailed description of the socioeconomic and structural characteristics of the individual's family of orientation as well as his place of origin. Intercohort compositional change on these factors, therefore, should adequately summarize the major sources of change in social background composition and hence provide an adequate means of estimating its impact on grade progression rate changes.

As noted above, we specify the effects of background and cohort membership on grade progression in terms of the logistic response model. Models are estimated using maximum likelihood procedures for nontabular observations (Cox, 1970; DuMouchel, 1976; Nerlove and Press, 1976).

3. EMPIRICAL RESULTS

This section presents our results on intercohort change in grade progression rates and the role of social background compositional change. First, it presents observed grade progression rates in the logistic and probability scales. Then it examines social background and cohort membership effects on grade progression when they are estimated simultaneously. The estimation affords grade progression rates adjusted for social background composition, which we compare to observed rates. We compare the two sets of rates graphically, and then test more explicitly the argument of the previous section.

Table 1 presents effect parameters for cohort membership for six school continuation decisions. They denote the effect of cohort

Table 1.—Coefficients Representing the Effects of Cohort Membership on School Continuation Decisions.

	Completes Elementary (0-8)	Attends High School Given Completes Elementary (8-9)	Completes High School Given Attends High School (9-12)	Attends College Given Completes High School (12-13)	Completes College Given Attends College (13-16)	Attends Post-College Given Completes College (16-17)
Constant	2.8710	3.0150	1.7019	0.1878	0.2067	-0.0005
1907-11	-1.2640	-1.6901	-0.8498	-0.1917	0.1161	-0.1961
1912-16	-0.8662	-1.3568	-0.7525	-0.5393	-0.3832	-0.3759
1917-21	-0.5447	-0.8507	-0.3031	-0.3481	-0.1907	-0.4384
1922-26	-0.3146	-0.5590	-0.3343	-0.1678	0.1697	-0.0595
1927-31	-0.4265	-0.2456	-0.1233	-0.0716	0.1821	0.0285
1932-36	-0.0458	0.1373	0.0969	0.0251	0.2406	0.1447
1937-41	0.3110	0.3017	0.1555	0.0615	0.1202	0.3151
1942-46	0.9176	0.9842	0.3486	0.1432	0.1697	0.1006
1947-51	1.0329	1.3147	0.6117	0.3920	-0.4682	-0.8756
"R^2"	.052	.110	.033	.087	.079	.056

NOTE: Dependent Variables are the log odds of continuing from one schooling level to the next for six levels of schooling. Estimates are based on 1973 sample of U.S. white male civilian non-institutional population born 1907-1951. For definition of "R^2" see Appendix.

membership on the log odds of grade progression relative to the mean log odds for the sample, which is given by the constant term. The "R^2" for each cohort classification model denotes the proportion of predictive error under the null hypothesis, which is reduced by considering cohort membership (see Appendix). As the "R^2" values indicate, there is substantial gross change in the log odds of grade progression only for the earliest schooling levels. Most notably, by this criterion, the greatest change occurs for the transition from elementary completion to high school graduation, where cohort membership explains 11 percent of the predictive error. The cohort pattern of grade progression is more clearly seen in Figure 1, where the sums of each effect parameter the constant in Table 1 have been plotted in the solid lines. (We discuss the dotted lines below.) The figure shows that the strongest trend in grade progression odds is indeed for the transition from 8th to 9th grade, whereas there are less extreme trends for the other transitions through college attendance. Beyond the transition from high school to college, there is little trend in progression rates. For each of the first four transitions, changes in effects are clearly dominated by the upward trend, which strongly suggests that changes in background levels have been particularly important here. For most of these transitions, it is also possible to detect the impact of factors other than an underlying background trend. For several of the transition rate series plotted in Figure 1, for example, grade progression for those cohorts making the transitions during the Depression is very low relative to the trend. Thus the 1927-31 birth cohort has a relatively low transition rate for 8th grade completion, the 1922-26 cohort a low rate for high

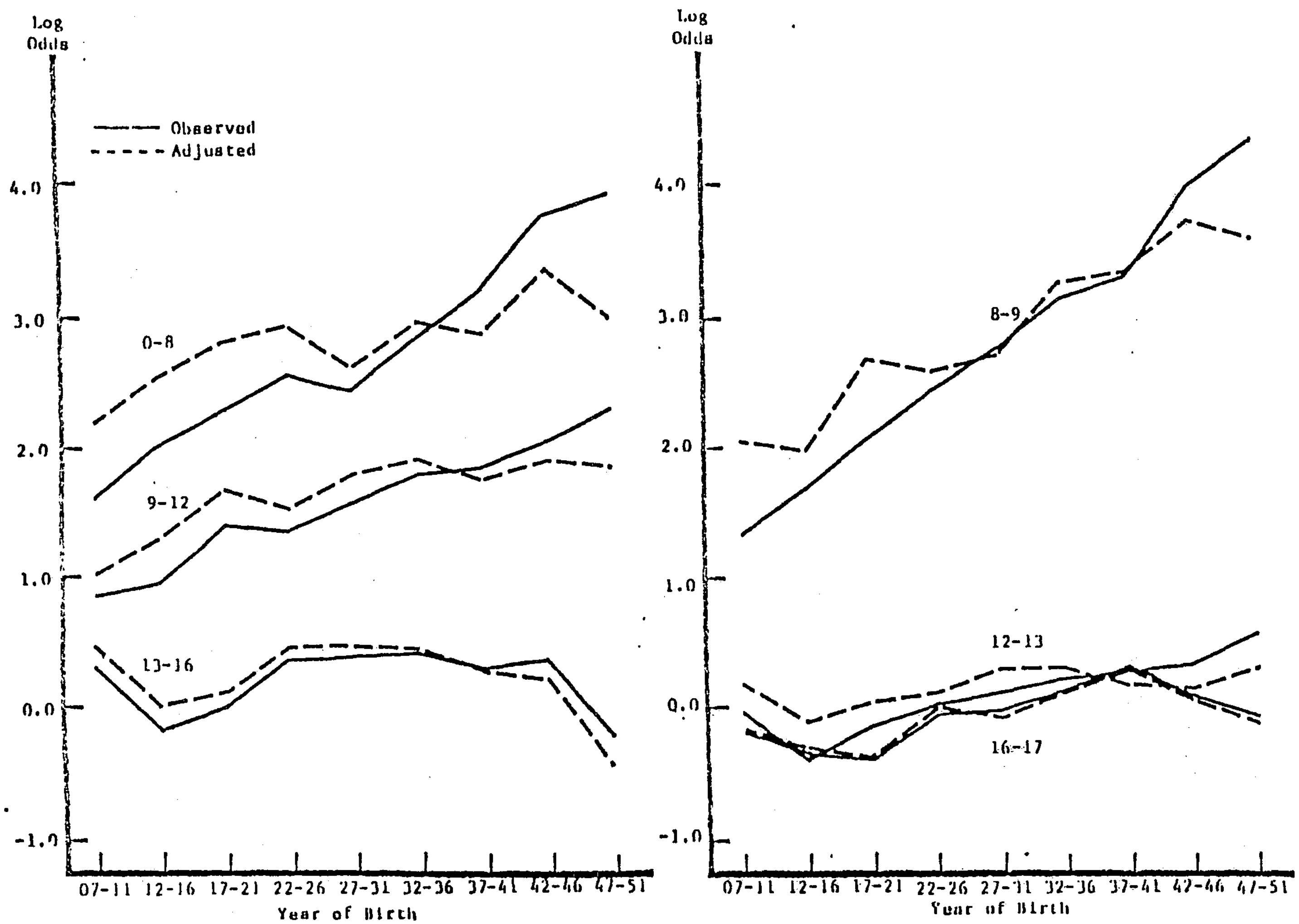

Figure 1.—Log Odds of Grade Progression, Observed and Adjusted for Social Background Composition for White American Male Cohorts Born 1907-1951.

school attendance, and the 1912-16 cohort a low rate for college attendance given high school graduation. It is reasonable to expect a corresponding fluctuation in the series for 9th grade attendance given 8th grade completion, but evidently it is swamped by the upward trend, presumably due to secular change in social background factors.

Figure 2 reports the same grade progression rates as Figure 1, but in the probability rather than the logit scale. In the probability scale, the secular patterns are no different from the logit scale, except for the obvious decreasing rate of progression rate growth at the lowest two levels of schooling where the rates approach unity.

Table 2 reports the effect parameters for the logistic response model in which both social background and cohort membership effects are estimated. Note that most of the coefficients for social background factors are broadly consistent with the assumption made above that background effects decline approximately monotonically from lower to higher schooling levels. Thus, for example, each year of father's schooling improves the odds of 8th grade completion by approximately 12 percent, whereas it improves the odds of college attendance given high school graduation by only 4 percent. There are similar patterns for mother's schooling and parental income, though not for father's occupation. Such deviations from a monotonic decline as the negligible father's occupational status effects during the pre-high school transitions and the particularly strong parental income effect on continuing from high

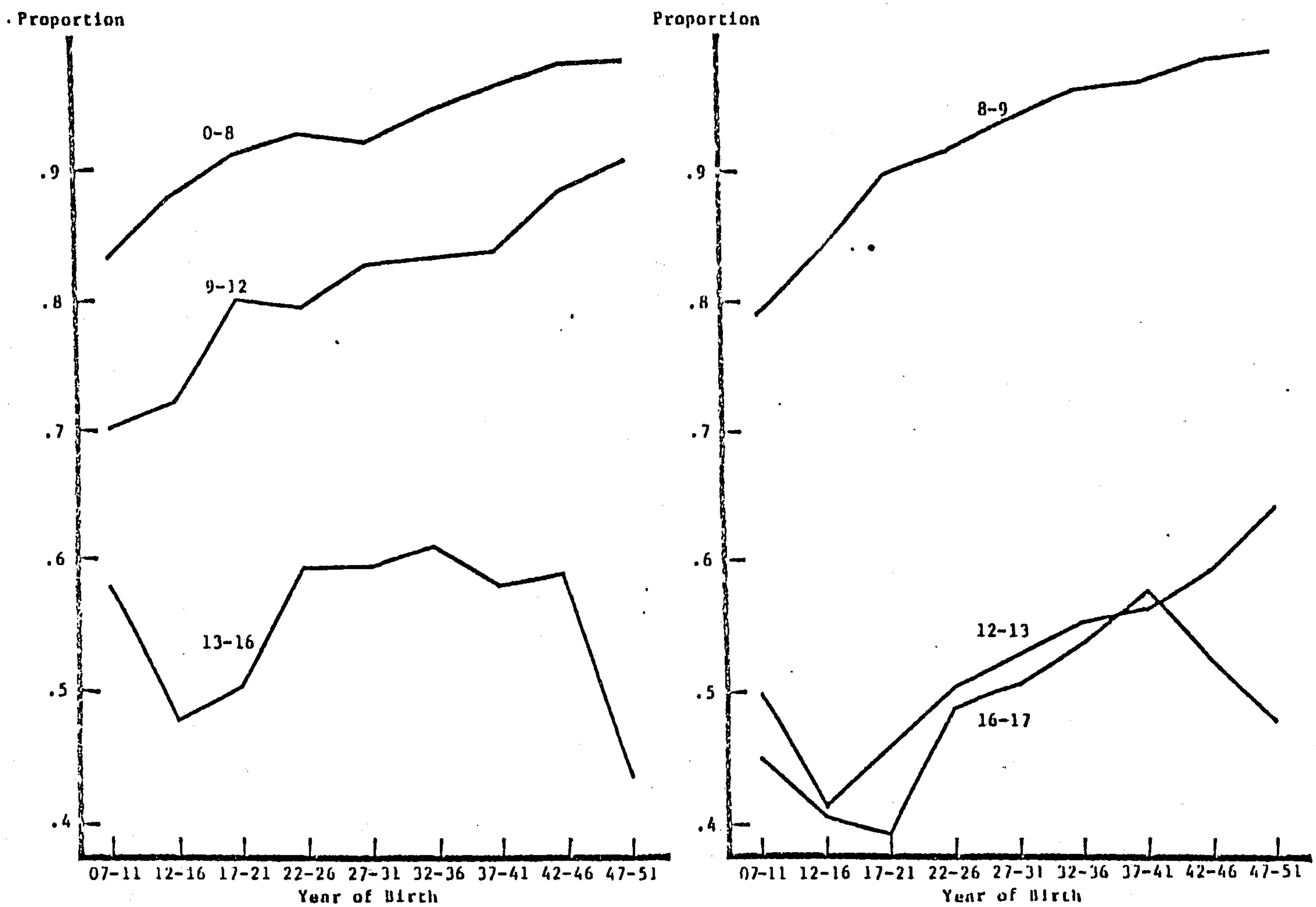

Figure 2.—Grade Progression Proportions for White American Male Cohorts Born 1907-1951.

Table 2.—Coefficinets Representing the Effects of Social Background Factors and Cohort Membership on School Continuation Decisions.

	Completes Elementary (0-8)		Attends High School Given Completes Elementary (8-9)		Completes High School Given Attends High School (9-12)		Attends College Given Completes High School (12-13)		Completes College Given Attends College (13-16)		Attends Post-College Given Completes College (16-17)	
	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$
Constant	1.1430	4.73	1.7430	7.19	-0.0242	-0.20	-1.6890	-15.10	-0.8333	-7.88	-0.4175	-2.97
FASEI	0.0076	1.42	0.0054	1.15	0.0166	8.35	0.0149	10.64	0.0114	9.06	0.0075	4.51
SIBS	-0.1282	-5.45	-0.1438	-6.30	-0.1306	-11.10	-0.1056	-9.41	-0.0707	-5.97	-0.0059	-0.35
FAMINC	0.0995	5.01	0.0467	3.16	0.0610	7.97	0.0438	9.15	0.0193	2.78	-0.0097	-2.14
FED	0.1180	4.69	0.0855	3.52	0.0759	6.48	0.0406	4.28	0.0181	2.08	-0.0048	-0.42
MED	0.1644	6.86	0.1044	4.51	0.0697	5.97	0.0888	8.62	0.0429	4.45	0.0285	2.25
BROKEN	-0.3319	-1.78	-0.1723	-0.87	-0.2208	-2.31	0.0027	0.03	-0.1941	-2.25	-0.3621	-2.98
FARM	-0.5532	-4.10	-0.9391	-6.93	0.3671	4.67	0.0284	0.38	0.1007	1.23	0.2150	1.81
SOUTH	-0.6358	-4.97	0.3419	2.43	-0.1448	-2.14	0.0227	0.38	-0.0696	-1.23	-0.2814	-3.75
1907-11	-0.6751		-0.9644		-0.6642		-0.0110		0.2765		-0.1576	
1912-16	-0.3496		-1.0236		-0.3802		-0.2965		-0.1838		-0.3175	
1917-21	-0.0674		-0.3021		-0.0424		-0.1413		-0.0716		-0.4093	
1922-26	0.0738		-0.4125		-0.1760		-0.0706		0.2555		-0.0116	
1927-31	-0.2347		-0.2844		0.0807		0.1333		0.2700		0.0759	
1932-36	0.1175		0.2699		0.2131		0.1209		0.2660		0.1381	
1937-41	0.0240		0.3492		0.0692		-0.0128		0.0740		0.2962	
1942-46	0.4833		0.7122		0.1962		-0.0350		0.0652		0.0576	
1947-51	0.1776		0.5675		0.1279		0.1192		-0.6404		-0.1509	
"R^2"	.279		.208		.127		.093		.038		.013	
$\chi_2^2 - \chi_1^2$ (8 df)	24.9		84.2		68.7		22.9		171.9		38.8	
N	5368		5009		9301		7732		7674		4185	
Subsample %	25.0		25.0		50.0		50.0		100.0		100.0	

NOTE: Dependent variables are the log odds of continuing from one schooling level to the next for six levels of schooling. Estimates are based on 1973 sample of U.S. white male civilian non-institutional population born 1907-51. Independent variables are: FASEI: Father's occupational Duncan socioeconomic index when respondent was 16; SIBS: Number of siblings; FAMINC: Annual income of family in thousands of constant (1967) dollars when respondent was 16; FED: Father's grades of school completed; MED: Mother's grades of school completed; BROKEN: Absence of one or both parents from respondent's household most of the time up to age 16; FARM: Respondent lived on a farm at age 16; SOUTH: Respondent born in the South census region. For definition of "R^2" see Appendix.

school attendance to graduation are entirely consistent with cross-sectional estimates that do not take cohort membership into account. (See Mare, 1976, for interpretation of these deviations from monotonicity in the cross-sectional results.)

The bottom of Table 2 reports for each schooling level the likelihood ratio chi-square statistic, which tests the null hypothesis that, net of social background, there is no effect of cohort membership on grade progression. With 8 degrees of freedom the test statistics recommend rejection of the null hypothesis for every school transition. On the other hand, given the very large sample sizes upon which these calculations are based, the impact of cohort membership net of background is apparently marginal for several school transitions. In particular, for both elementary completion and college attendance the cohort effects are barely significant. By themselves, of course, these tests reflect both the total amount of intercohort change and the importance of background in producing this change. It is useful, therefore, to examine the separate cohort effects directly and to compare them to cohort effects that do not take account of social background.

Log odds of grade progression adjusted for cohort composition on social background can be calculated from the effect parameters in the bottom half of Table 2; that is, we calculate cohort average log odds, assuming that each cohort is at the grand mean level of the social background variables. These adjusted grade progression rates in the logistic scale are graphed in the broken lines in Figure 1. Figure 1 shows that the effect of adjusting for social background is to attenuate intercohort contrasts in grade progression rates and, in particular, to eliminate much of the trend in the rates. The extent to which adjusted levels of grade progression conform to observed levels is, as noted in the previous section, the degree to which changes in observed levels are independent of social background compositional changes. Conversely, where levels of adjusted rates are considerably attenuated versions of corresponding unadjusted rates, background changes have a relatively strong impact on grade progression rate changes.

Though upward trends in the log odds of grade progression remain in the adjusted series for the first four schooling levels, Figure 1 shows that adjusting for social background has considerable impact at these levels. In each instance the adjusted rates show less of a time trend and more pronounced fluctuations about the trend that remains, suggesting the cyclical influence of the economy on progression rates. By contrast, at the two highest schooling levels, there is close correspondence between observed and adjusted log odds of grade progression, indicating that the importance of social background changes is negligible at these schooling levels. In short, Figure 1 suggests that social background compositional changes are very important determinants of intercohort change in progression rates through the level of college attendance and negligible thereafter.

This conclusion is consistent with the argument in the previous section of this paper. It is informative, however, to compare observed and adjusted log odds of grade progression more precisely by summarizing the information in Figure 1. To do this we calculate the regression of adjusted log odds of grade progression on observed log odds for each school transition. From this, it is possible to quantify the relative importance of background and nonbackground factors by means of the decomposition outlined in the previous section.

Table 3 summarizes the regression of adjusted on observed grade progression log odds. Consistent with our formal argument and visual impressions, the proportions of change in observed rates due to nonbackground factors is larger at the higher than at the lower school transitions. The six levels of schooling can be characterized by two levels of importance of social background adjustment: the first four school transitions where the adjustment has the largest effect; and the final two transitions where the effect of background adjustment is small. The two levels are reflected in the final column of Table 3, which shows the proportion of intercohort differences due to social background compositional changes at each level of schooling. For the two levels, the shares of change due to background are between 40 and 60 percent and less than 25 percent respectively. These results, therefore, appear broadly consistent with Hauser and Featherman's observation (1976) that social background accounts for approximately one third of change in average attainment levels over cohorts born 1907 through 1951.

Table 3 also reports standard deviations for the observed and adjusted log odds of grade progression. Consistent with the observed log odds of progression reported in Table 1, the standard deviations of the observed rates show greatest variability at the lowest schooling levels, and particularly for the transition between 8th and 9th grades.

Table 3.—Regression of Adjusted on Observed Log Odds of Grade Progression for Six Schooling Levels Over 9 Five-Year Cohorts Born 1907-11 through 1947-51.

Transition	Intercept	Slope	Standard Error of Slope	R^2	Standard Deviation of Observed	Standard Deviation of Adjusted	Proportion of Change Due to Background[a]
Elementary Completion	-0.001	0.385	0.056	0.787	0.772	0.335	0.615
High School Attendance Given Elementary Completion	-0.002	0.597	0.060	0.930	1.011	0.634	0.403
High School Graduation Given High School Attendance	0.005	0.538	0.105	0.789	0.486	0.294	0.462
College Attendance Given High School Graduation	0.009	0.400	0.119	0.618	0.275	0.140	0.600
College Graduation Given College Attendance[b]	-0.097	0.788	0.152	0.788	0.220	0.178	0.212
Post-College Attendance Given College Graduation[b]	0.013	0.904	0.047	0.987	0.261	0.238	0.096

NOTE: Calculations are based on log odds of grade progression reported in Tables 1 and 2.

a--If the slope of the equation is b, then the proportion of change due to background is 1 - b.

b--Equation is estimated over 8 five-year cohorts born 1907-11 through 1942-46.

The standard deviations of the adjusted log odds show that despite the greater relative importance of social background factors at the lowest schooling levels, the odds of grade progression are still more variable early in the schooling process after taking background into account. Conversely, although nonbackground sources of change in grade progression rates are relatively more important than background shifts at the post-secondary level, their absolute effect is less than it is at the earliest schooling levels. In short, there is much more change in progression rates at the earliest schooling levels and both background and nonbackground sources of variability are greatest there.

Finally, Table 3 reports the amount of variance in observed grade progression odds explained by adjusted odds. Although there is no evident schooling level pattern in the correlation beween observed and adjusted log odds of grade progression, it is notable that for the transition between high school and college the adjusted rates explain only about 60 percent of the variance in the observed. As noted above, it is usual in aggregate econometric studies of college enrollment not to adjust enrollment series for variation in social background composition. These studies, moreover, typically examine a number of significantly colinear variables over relatively small numbers of observations. This suggests that aggregate social background levels may be consequential excluded variables in these analyses, and appraisals of the effects of market and institutional factors may be thereby distorted. Over the experience of cohorts observed in our analysis, observed and adjusted progression rates between high school and college are not at all the same variables, and any credible analysis of market variables should take account of their effects.

4. IMPLICATIONS

This analysis demonstrates that the character of intercohort growth in grade progression rates varies considerably over levels of the formal schooling process. The representative school transitions considered differ in both the absolute and relative effects of changes in social background composition on progression rates. Although it is beyond our concerns to forecast explicitly future change in either average levels of educational attainment or particular grade progression rates, the analysis suggests several aspects of educational growth not emphasized by previous researchers.

Social background compositional changes have played a substantial role in increasing college attendance rates, but much of this effect has been through the effects of background changes on grade progression changes at transitions below the college level. As noted above, close to 80 percent of change in proportions of persons attending college results from intercohort changes in progression rates below the college level. And, as Table 3 showed, it is at these early schooling levels where the relative importance of background changes is greatest. The information in Table 3, therefore, suggests that approximately 50 percent of change in college completion rates is due to background, with 40 percent due to background effects at previous schooling levels and 10 percent due to background effects at the college level. Thus the quantitative impact of change in progression from high school to college generally and the background component of this change in particular on growth in college attendance is quite small.

In contrast to past growth in college attendance, however, most future growth will occur through increases in proportions of high school graduates attending college, rather than an increase in cohort fractions completing high school. As Figure 2 shows, transition rates below the college level now all exceed 90 percent, whereas the transition rate between high school and college for the cohort born between 1947 and 1951 is (as of 1973) less than 65 percent. Though the relative importance of social background at the transition between high school to college is as great as at the earlier levels (with the exception of 8th grade completion), its absolute importance is substantially less. As Table 2 shows, family background influences are typically weaker on progression rates at the college level than at previous levels. With the exception of number of siblings, which has a virtually uniform effect on progression up through college attendance, those family characteristics most likely to show future secular change, notably parental education and income levels, have diminishing effects over schooling levels. As a consequence, therefore, future changes in social background favorable to increased college attendance must be larger than past changes in order to have the same quantitative impact they have had in past cohorts of students. Similarly, if as some have suggested, there will be growing market disincentives for high school graduates to invest in further schooling as a result of excess supplies of college graduates in the population, larger shifts in social background levels than have occurred in past cohorts would be necessary to offset negative aggregate influences and maintain high rates of college attendance.

More generally, since future growth in cohort average grades of schooling completed will rely more heavily on grade progression rate increases at the college level, background compositional shifts may have diminishing (albeit still strongly positive) marginal effects on average attainment. This suggests that without major changes in the institutional and market incentives to continue with schooling, schooling level differentiation in the role of social background influences may be a major source of inertia to long run changes in the average educational status of the population.

Having expressed this tentative conclusion, however, we should also note a qualification. The analysis of this paper has been considerably more disaggregated than previous empirical work, which assumes fixed relations between social origins and educational attainment over the schooling process. On the other hand, we have assumed throughout a cohort-invariant regime of relations between background and grade progression. It remains possible, therefore, that intercohort changes in the effects of social background on formal schooling may mitigate the tendencies described here.

APPENDIX

The "R^2" measure of fit is due to DuMouchel (1976). Consider the model

$$\log_e\left[\frac{p(y_i=1)}{1-p(y_i=1)}\right] = \beta_o + \Sigma\beta_k X_{ik}$$

where y_i is a binary response variable taking the values 1 or 0 for the i<u>th</u> individual, X_{ik} is the value on the k<u>th</u> independent variable for the i<u>th</u> individual and the β_k are parameters. Define the predictive error of the model under the null hypothesis that $\beta_k = 0$ for all k as

$$\Pi_y = 1 - p^p(1-p)^{1-p}$$

and the predictive error under the estimated model as

$$\Pi_\varepsilon = 1 - \exp[E_{y_i X_i} \log_e p(y_i|X_i)]$$

where p is the overall probability that y = 1 and X_i is a (1 x K) vector of values on the K predictor variables for the i<u>th</u> individual. Then

$$"R^2" = \frac{\hat{\Pi}_y - \hat{\Pi}_\varepsilon}{\hat{\Pi}_y} .$$

For further details, see DuMouchel (1976, pp. 6-10).

Appendix Table 1.—Coefficients Representing Effects of Social Background Factors on School Continuation Decisions.

	Completes Elementary (0-8)		Attends High School Given Completes Elementary (8-9)		Completes High School Given Attends High School (9-12)		Attends College Given Completes High School (12-13)		Completes College Given Attends College (13-16)		Attends Post-College Given Completes College (16-17)	
	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$
Constant	0.9886	4.22	1.2410	5.40	-0.1778	-1.48	-1.7440	-15.98	-0.6434	-6.33	-0.4669	-3.42
FASEI	0.0075	1.42	0.0041	0.87	0.0154	7.82	0.0145	10.49	0.0115	9.28	0.0070	4.24
SIBS	-0.1325	-5.67	-0.1444	-6.40	-0.1335	-11.39	-0.1067	-9.53	-0.0737	-6.30	-0.0138	-0.84
FAMINC	0.1067	5.36	0.0587	3.79	0.0655	8.57	0.0444	9.24	0.0097	2.68	-0.0110	-2.44
FED	0.1188	4.79	0.0939	3.96	0.0784	6.77	0.0420	4.47	0.0071	0.84	-0.0050	-0.45
MED	0.1677	7.16	0.1243	5.56	0.0815	7.11	0.0940	9.29	0.0361	3.86	0.0383	3.11
BROKEN	-0.3163	-1.71	-0.1256	-0.64	-0.2192	-2.30	-0.0078	-0.09	-0.1567	-1.84	-0.3713	-3.08
FARM	-0.6060	-4.54	-1.0560	-7.94	0.3013	3.88	0.0107	0.14	0.1138	1.41	0.1826	1.55
SOUTH	-0.5948	-4.70	0.4182	3.03	-0.0973	-1.45	0.0309	0.53	-0.0604	-1.08	-0.2736	-3.66
"R^2"	.270		.178		.120		.091		.026		.008	
N	5368		5009		9301		7732		7674		4185	
Subsample %	25.0		25.0		50.0		50.0		100.0		100.0	

NOTE: Dependent variables are the log odds of continuing from one schooling level to the next for six levels of schooling. Estimates are based on 1973 sample of U.S. white male civilian non-institutional population born 1907-1931. Independent variables: FASEI: Father's occupational Duncan socioeconomic index when respondent was 16; SIBS: Number of siblings; FAMINC: Annual income of family in thousands of constant (1967) dollars when respondent was 16; FED: Father's grades of school completed; MED: Mother's grades of school completed; BROKEN: Absence of one or both parents from respondent's household most of the time up to age 16; FARM: Respondent lived on a farm at age 16; SOUTH: Respondent born in the South census region. For definition of "R^2" see Appendix.

REFERENCES

Blau, Peter M. and O. D. Duncan. 1967. The American Occupational Structure. New York: John Wiley and Sons.

Cox, D. R. 1970. The Analysis of Binary Data. London: Methuen and Co., Ltd.

Dresch, S. P. 1975. Demography, Technology, and Higher Education: Toward a Formal Model of Educational Adaptation. Journal of Political Economy 83:535-569.

DuMouchel, W. H. 1976. On the Analogy Between Linear and Log-Linear Regression. Technical Report No. 67. University of Michigan, Department of Statistics.

Duncan, Beverly. 1968. Trends in Output and Distribution of Schooling. Pp. 601-672 in Eleanor B. Sheldon and W. E. Moore (eds.), Indicators of Social Change. New York: Russell Sage Foundation.

Featherman, D. L. and R. M. Hauser. 1975. Design for a Replicate Study of Social Mobility in the United States. Pp. 219-251 in Kenneth C. Land and S. Spilerman (eds.), Social Indicator Models. New York: Russell Sage Foundation.

Freeman, R. B. 1975. Overinvestment in College Training? Journal of Human Resources 10: 287-311.

Hauser, R. M. 1970. Educational Stratification in the United States. Pp. 102-129 in Edward O. Laumann (ed.), Social Stratification: Research and Theory for the 1970s. Indianapolis: The Bobbs-Merrill Company, Inc.

Hauser, R. M. and D. L. Featherman. 1976. Equality of Schooling: Trends and Prospects. Sociology of Education 49:99-120.

Mare, Robert D. 1976. Social Background and School Continuation Decisions. Paper presented to the meetings of the Population Association of America, St. Louis, Missouri.

_____. 1977. Growth and Distribution of Schooling in White Male American Cohorts: 1907-1952. Unpublished Ph.D. dissertation. Ann Arbor: University of Michigan.

Nerlove, Marc and S. J. Press. 1976. Multivatiate Log-Linear Probability Models for the Analysis of Qualitative Data. Discussion Paper No. 1. Northwestern University, Center for Statistics and Probability.

Sewell, William H. and R. M. Hauser. 1975. Education, Occupation, and Earnings: Achievement in the Early Career. New York: Academic Press.

U. S. Bureau of the Census. 1960. Historical Statistics of the United States: Colonial Times to 1957. Washington, D. C.: U. S. Government Printing Office.

_____. 1976. Educational Attainment in the United States March 1975, Current Population Reports, Series P-20, No. 295. Washington, D. C.: U. S. Government Printing Office.

Winsborough, Hal H. and J. A. Sweet. 1976. Life Cycles, Educational Attainment, and Labor Markets. Paper presented to the meetings of the American Sociological Association, New York.