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ABSTRACT

In this paper, logistic response models of the effects of parental socioeconomic characteristics and family structure on the probability of making selected school transitions for white American males are estimated by maximum likelihood. As a consequence of the pattern of differential attrition, parental socioeconomic effects decline sharply from the earliest school transitions to the latest. Implications of differential socioeconomic background effects over schooling levels for understanding changes in level and distribution of schooling are discussed.

Social Background and School Continuation Decisions

In the American population individuals possess fixed levels of formal educational attainment for most of their adult lives. Once they enter the labor market in their late teens or early twenties, their schooling is essentially complete. Though some persons acquire additional schooling subsequent to initial withdrawal from school, it is an exceptional individual who leaves the labor market in mid-life to pursue substantial further schooling.

Prior to labor market entry, however, schooling is not a fixed status. Instead, formal educational acquisition is a sequence of age-graded events. At approximately age six birth cohorts become school-entry cohorts, which suffer attrition as some of their members terminate school and others delay it and continue with later cohorts. Eventually, all members of school-entry cohorts have permanently discontinued their schooling. At that point the grades of schooling distribution within the cohort is determined. Thus the educational attainment process for the cohort takes approximately 20 years and, for individuals, has lengths approximately proportional to their ultimate numbers of grades completed.

Contemporary sociological research on determinants of educational attainment focusses heavily on social background effects on grades of formal schooling completed. Much is known about the effects of family structure and socioeconomic status on final educational attainment (Blau and Duncan, 1967; Duncan, 1968; Duncan, Featherman, and Duncan, 1972); the social psychological processes transmitting social background effects (Hauser, 1970; Sewell and Hauser, 1975); and the temporal stability of background effects (Hauser and Featherman, 1976). To the extent that one seeks a simple characterization of ultimate educational status, completed grades of schooling is a suitable measure. Moreover, insofar as there are fixed relations between grades of schooling and subsequent socioeconomic achievements, the relationship between family background and grades of schooling is a pivotal link in intergenerational socioeconomic status transmission.

For other purposes, however, it is appropriate to examine family background effects on the separate school continuation decisions that constitute total grades of school completed. To do so is to deepen our understanding of how educational attainment depends on family structure and socioeconomic characteristics. Because the accumulation of schooling takes a number of years, the determinants of school continuation decisions may not be the same at all levels of schooling. All phases of schooling do not require the same familial resources and structural advantages. Nor is the individual equally dependent upon the family of orientation throughout the schooling years. In short, to examine separately the sequence of school continuation decisions is to further unravel the early stages of the socioeconomic life cycle.

Apart from their importance as life cycle stages, some school continuation decisions are of intrinsic significance. There has been substantial recent research and speculation, for example, on the effects of changes in aggregate economic returns to college education on changes in college attendance rates (Dresch, 1975; Freeman, 1975; 1976). A weakness of these attempts to model aggregate attendance rate changes is their failure to adjust enrollment series for intercohort variation in family background composition. Secular variation in average levels of family factors affecting college attendance decisions will produce change in attendance rates independently of the influence of aggregate market factors. Valid compositional adjustments to enrollment series require explicit models of family background effects on attendance decisions.

Decomposing the process of educational attainment into a sequence of attendance decisions also casts light on change in the intergenerational transmission of educational status. There are declines in family socioeconomic effects on grades of schooling over male cohorts born in the first half of the twentieth century (Hauser and Featherman, 1976). For cohorts born in the first decade of the century, for example, each year of father's schooling is worth slightly more than one-fourth of a grade of son's schooling. For Post-World War II cohorts the marginal impact of a grade of father's schooling on son's schooling is less than one-sixth of a grade. There are similar changes in the impact of father's occupational status (Hauser and Featherman, 1976, p. 109). A source of these changes may be intercohort shifts in the interval over which there is greatest variance in educational attainment. For cohorts born early in the century, most of the variation in grades of school completed is below the college level. Later cohorts experience close to universal high school graduation. Hence their variation in school completion levels occurs primarily in the post-secondary years. If family background effects are not invariant over schooling levels, but instead are stronger in the earlier years of schooling, then the overall effect of social background on grades of schooling should gradually decline.

In short, the relationships between social background and the sequence of school continuation decisions are important components of the process of educational stratification and a basis for understanding its changes. Despite the importance of detailed analysis of school continuation decisions, there has been scant systematic research on the subject. We know little about variation in social background effects and the relative importance of the various dimensions of socioeconomic background over schooling levels. The analysis reported in this paper attempts to fill this gap in our understanding by examining the effects of family structure and socioeconomic status on school continuation decisions for cohorts of white American men born in the first half of the twentieth century. This paper is organized as follows: section 1 discusses conceptualization of school continuation decisions, our data source, the social background measures included in the analysis, and statistical procedures. Section 2 discusses social background effects on school continuation decisions and argues that they should vary systematicallt across levels of schooling. Section 3 presents the results of the analysis. The paper concludes with a summary and discussion of the implications of the analysis.

1. ANALYTIC STRATEGY, DATA, AND METHODS

School Continuation Decisions

To study social background effects on school continuation decisions requires the same survey information as to study the determinants of grades of schooling, to wit, retrospective measure of background characteristics and grades of school completed. Given that we know how far a man goes in school, we can deduce his continuation decisions at each grade up to his highest grade completed. For some continuation decisions, however, we want to know whether a man attended a particular grade of schooling, given that he completed the previous grade; for others we want to know whether he actually completed a particular grade. Thus we ascertain both the respondent's highest grade of schooling attended, and also whether he completed that grade. With these variables in hand, we construct a sequence of dichotomous variables denoting whether the individual completed (or attended) each level of schooling of interest.

In examining schooling transitions we focus only on persons who completed the transition prior to the one of interest rather than on all persons. Analyzing the causes of college attendance for all persons in the population, for example, confounds the effects of social background on making the transition from high school to college with the cumulative impact of family background over all previous levels of schooling. For each level of schooling, therefore, we analyze the decisions of persons at that level whether to continue to the next level. Thus we examine social background effects over a sequence of overlapping populations, which diminish as they proceed from lower to higher levels of schooling.

If a data source arrays highest grade of schooling attended from zero to "k or more," then it is possible to construct k dichotomous variables representing the complete set of continuation decisions. Not all decisions, however, are of equal substantive interest. Our strategy, therefore, is to analyze transitions beween and across the major institutional divisions of the educational system, while simultaneously characterizing the entire educational distribution. We examine the following school continuation decisions: whether the individual

1. completes elementary school (completes 8th grade);
2. attends high school given that he has completed elementary school (attends 9th grade given completion of 8th grade);
3. graduates from high school given that he attends high school (completes 12th grade given attends 9th grade);
4. attends college given that he completes high school (attends 13th grade given completes 12th grade);
5. graduates from college given that he attends college (completes 16th grade given attends 13th grade);
6. attends graduate level education given that he completes college (attends 17th grade given completes 16th grade).

These transitions represent entry into and completion of the principal institutional stages of American formal schooling. In particular, they focus explicitly on the year to year transitions that have historically been the points of the largest attrition from formal schooling and aggregate over the detailed transitions which have produced more gradual attrition (Duncan, 1968, p. 640).

Data

Our analysis employs two sources of data. The principal source is the 1973 Occupational Changes in a Generation (OCG) Survey. For a detailed description of the survey design see Featherman and Hauser (1975). The OCG data were gathered as 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, school history, and family background of approximately 33,500 men. Because of its size, quantity of detailed family background information, and overall quality, the OCG Survey is among the best sources of data for analyzing socioeconomic background effects on school continuation decisions.

As discussed below, the OCG data are limited for our purposes by their lack of measures on factors known to intervene between characteristics of the family and educational attainment. Thus we employ a second data set, the 1964 survey of veterans of the U.S. military. These data were gathered as a supplement to the October, 1964 CPS for approximately 3000 veterans aged 18 to 34 and merged with additional information from their military record, including their scores on the Armed Forces Qualifying Test (AFQT). More detailed information on this sample is provided in Klassen (1966) and Rivera (1965).

Social Origin Variables

This section enumerates the social background variables which we include in the analysis, their units of measurement, and their general limitations. The substantive rationale for their inclusion is presented in the next section. The variables include: 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 (1961) 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 at age 16 and zero otherwise.

These variables have two important limitations for the proposed analysis. First, the values of these variables may better represent the family conditions respondents experience at some levels of schooling than at others. Several of the variables pertain explicitly to circumstances when the respondent was 16 years old. Thus they are most likely better predictors of schooling decisions made in the high school years than of those made in the elementary or college years. This has implications for interpreting continuation decisions models. We wish to compare coefficients in equations corresponding to the same independent variables over continuation decisions. If the variables corresponding to the coefficients are more representative of family conditions experienced at one continuation point than at another, then coefficient differences due to real changes in background effects over schooling levels may be confounded with reliability differentials beween the independent variables at the two schooling levels. In the absence of multiple indicators for the family background variables, it is impossible to explicitly correct for unreliability in the statistical estimation of effects. Hence measurement error for the family background variables must be regarded as a possible source of observed coefficient differences.

A second limitation of these variables for the analysis of background effects on school continuation is that they include no factors intervening between background and educational attainment. Mental ability and peer and parental influences, for example, are increasing functions of parental socioeconomic characteristics and themselves have significant positive effects on attainment (for example, Sewell and Hauser, 1975). Our interpretations of variation in the effects of social background are only as good as our understanding of the intervening mechanisms responsible for them. We shall, therefore, present results from the 1964 veterans sample that includes a measure of mental ability (AFQT) in addition to measures of social background and educational attainment. The veterans sample, however, has a number of limitations. It excludes several important family background measures, notably parental income, mother's schooling, and number of siblings. In measuring educational attainment it records only whether an individual completes each grade of schooling, and not whether he attended the grade. Thus uncompleted grades are not measured in the survey and school transitions cannot be measured precisely as we have defined them above. Although it does measure mental ability, the survey, like OCG, includes no other measures of variables which transmit family background effects on educational attainment. Finally, because the sample is restricted to veterans it does not represent any cohort of draft age men: specifically, it underrepresents men at the extremes of the ability distribution, who would have been most likely not to do military service (Griliches and Mason, 1973, pp. 288-289). On balance, it is helpful to analyze the relationship between social background and grade progression, taking mental ability into account, and thus worthwhile to consider results from the veterans survey. But these results are necessarily less definitive than those based on OCG, and make it necessary to interpret our findings by applying the results of other attainment process research that has explicitly examined intervening mechanisms in samples of more restricted populations.

Statistical Methods

To assess the effects of social background on school continuation decisions is to predict a set of dichotomous dependent variables. Thus for each of the school transitions we employ the logistic response model to estimate background effects. Thus our equations are of the form

$$\log_e \left(\frac{p_{ij}}{1 - p_{ij}}\right) = \beta_{j0} + \sum_k \beta_{jk} X_{ijk} \tag{1.1}$$

where p_{ij} is the probability that the ith individual will make the jth school transition, X_{ijk} is the value for the ith individual deciding whether to make the jth transition on the kth independent variable, and the β_{jk} are parameters to be estimated from the data. Equation (1.1) can be estimated using maximum likelihood methods (Cox, 1970; DuMouchel, 1976; Nerlove and Press, 1973).

The logistic specification is appropriate here because it provides unbiased parameter variance estimates, thereby making statistical inference possible, and represents the dependent variable in a form that may be reasonably regarded as uniformly affected by unit changes in the independent variables. In short, when the dependent variable is in the logit scale linear effects are reasonable and inferences about the effects are valid.

A related feature of the logistic response model requires special emphasis in this context. Associations estimated under such models are invariant under changes in the marginal distributions of the variables (Bishop, Fienberg, and Holland, 1975, pp. 9-15). Thus social background effects on continuation do not depend upon the average continuation rate, as they would were the dependent variable a simple dichotomy. As a consequence, we are free to choose whatever continuation decisions are substantively important without fear that differences in background effects among levels of schooling will be confounded with the mean levels of the dependent variables. Similarly, our interpretations of background effect differences cannot be based on assumptions about changing distributions of either independent or dependent variables. Changes in the distributions of the independent variables--among the categories in which they are measured--cannot induce changes in their effects. Effect differences, therefore, are due to genuine differences in the associations between measured variables over populations.

2. FAMILY BACKGROUND AND SCHOOL CONTINUATION DECISIONS

Although the variables enumerated in the previous section are typically included in models of the socioeconomic attainment process, there has been little attempt by previous researchers to speculate upon or appraise empirically variations in their effects across levels of schooling.

There has been some conjecture on whether parental socioeconomic status effects on school continuation increase or decrease by schooling level. Sewell and Shah (1967) assert that socioeconomic background effects are negligible up through the high school years because school attendance is largely regulated by legal norms. (Beyond high school, they show empirically that parental socioeconomic status effects on college attendance are considerably stronger than on college graduation given college attendance.) Nam and Folger (1965) distinguish between "socioeconomic status" and "financial factors" and argue that the former has a moderately strong effect on school retention at the compulsory ages and in progressing to college, but a smaller effect on high school graduation per se, while the latter should affect school continuation only at the college level.

These speculations, however, fail to recognize the formal properties of the schooling process. The argument that school continuation decisions in the pre-college years are largely determined by the law or other global features of American society and hence cannot be strongly affected by family socioeconomic characteristics confuses average levels of school continuation with the association between social background and continuation decisions. Throughout the twentieth century the proportion of American males completing elementary school (8th grade) has fluctuated between .68 and .92, while the proportion of high school graduates attending college has fluctuated between .41 and .53 (Duncan,1968, p. 640). Hence the variance of the former continuation decision has been between .07 and .22, while the latter has been approximately .25. The much smaller variance for the earlier transitions implies, ceteris paribus, a smaller linear effect of social background on school continuation. Yet the smaller linear effect is an artifact of the ceiling that the earlier continuation proportions have attained. Quite apart from the importance of socioeconomic selectivity for determining who continues and drops out, the linear effects of socioeconomic background are attenuated by high continuation rates. When we employ a measure of association that separates the proportion continuing from the association between continuing and relevant independent variables, the effects of socioeconomic background may be considerable at the earliest schooling levels.

This argument does not imply that social background effects should increase or decrease over schooling levels, but only that the pattern of effects should not be deduced from differences in proportions continuing at each level of schooling. There is, of course, prima facie reason to expect family socioeconomic characteristics to have particularly strong effects on the decision to pursue post-secondary schooling. Despite public subsidy of higher education, it requires tuition payments, fees, and transportation costs that are not required during the public school years. Moreoever, through financing college attendance, higher status families have been able, for most of this century, to ensure transmission of their relative status position to their sons. On the other hand, these effects must be weighed against the impact of socioeconomic selectivity in determining the small minorities who leave school prior to high school graduation. When average school continuation rates are high, only the very disadvantaged fail to continue. When continuation rates are lower, as they are at the highest levels of schooling, the normative constraints guaranteeing virtually universal high school graduation by persons from middle and upper status backgrounds are no longer present and social origin effects may be weakened. In short, our general knowledge of the importance of family socioeconomic status for schooling does not point to the schooling levels where its effects are strongest.

There are, however, compelling formal reasons to expect background effects to weaken steadily from the earliest schooling levels to the latest. Parental socioeconomic characteristics influence educational attainment through mental ability, grades, and the selective influences of peers, parents, and teachers (Sewell and Hauser, 1975). The total effects of parental characteristics on school continuation decisions, therefore, depend on the covariance structure of parental characteristics and intervening variables. Over schooling levels, differential rates of attrition imply changes in the covariance structure. More specifically, the effects of parental characteristics on the intervening variables are weakened, and thus the total effects of parental socioeconomic characteristics are reduced. This is best seen through a simple formal argument.

Suppose we have only a single family socioeconomic variable, say father's grades of school completed (F), and that the father's schooling effect is transmitted principally--though not exclusively--through a single variable, say mental ability (Q). (This example does in fact have verisimilitude. Sewell and Hauser show for 1957 Wisconsin high school seniors that the effect of father's schooling on son's post-secondary grades of schooling is primarily transmitted through ability; and that of all the parental SES measures predicting ability, father's schooling has the strongest effect [1975, pp. 99-100].) Denote the probability of continuing from one level of schooling to the next by p. Then, since father's schooling and ability have independent effects on grade progression, we have the following two equation model for the <u>tth</u> school transition:

$$\log_e \left(\frac{p_{it}}{1 - p_{it}}\right) = \beta_{t0} + \beta_{t1}F_i + \beta_{t2}Q_i \tag{2.1}$$

$$Q_{it} = \gamma_0 + \gamma_t F_i + v_i, \tag{2.2}$$

where i indexes individuals, v is a randomly distributed stochastic disturbance, and β_{t0}, β_{t1}, β_{t2}, γ_0, and γ_t are parameters. Our data do not have a measure of mental ability and, in any case, it is the total effect of father's schooling in which we are interested. So instead of (2.1) and (2.2) we estimate the reduced form equation:

$$\log_e \left(\frac{p_{it}}{1 - p_{it}}\right) = b_{t0} + b_{t1}F_i, \tag{2.3}$$

where b_{t0} and b_{t1} are parameters.

Now we can apply the standard omitted variable formula to (2.3) to get

$$E(\hat{b}_{t1}) = \beta_{t1} + \gamma_t \beta_{t2} , \tag{2.4}$$

where $\hat{b}_{t1}$ denotes the maximum likelihood estimate of b_{t1}.[1] Equation (2.4) shows that the reduced form effect is comprised of three components--the independent effect of father's schooling β_{t1}, the independent effect of mental ability β_{t2}, and the zero order relation between mental ability and father's schooling γ_t. Any one of the three components could vary over schooling levels to produce changes in b_{t1} as estimated in the various school continuation equations. We know little, however, about how the two direct effects should change. If we knew how β_{t1} changes over schooling levels, then we would probably know how b_{t1} changes, since we have even less information about the former than the latter. (We know that b_{t1} is partly due to the covariance of father's schooling and ability but, by definition, none of β_{t1} is.) It is similarly difficult to intuit how the effects of ability should change over schooling levels. Ability may play a larger role at the higher, more selective levels of schooling; but it is likely that those who cannot make the transition at the lower levels are mentally handicapped, implying a strong relationship between ability and continuation at those levels.

We know more about how γ_t changes. Specifically, the impact of differential attrition upon the distribution of Q and the joint distribution of Q and F implies that γ_t is likely to decline steadily over schooling levels. At the outset of the schooling years, the distribution of Q represents the distribution of ability for approximately the entire cohort. Thus the distribution may reasonably be assumed to be unimodal and symmetric. Over school transitions, attrition does not occur randomly with respect to Q but rather falls more heavily on persons with lower ability. The impact of attrition is to concentrate the distribution of Q, and thus the higher the level of schooling, the lower the variance of Q.[2] A decline in the variance of Q over schooling levels does not guarantee declines in γ_t, since changes in γ_t depend on how the decline in the variance of Q is allocated between the parts of Q's variance which are independent of F (variance within levels of F) and dependent upon F (variance between levels of F). In addition, changes in γ_t depend upon changes in the variance of F over schooling levels. For the purposes of our argument, it suffices to assume that variance declines in Q are not concentrated strictly in variance within levels of F. Only in that extreme case would the hypothesized decline in γ_t fail to occur. As for the variance of F, there is empirical evidence that changes in the dispersion of family background distributions over schooling levels are relatively slight. Table 2 reports standard deviations of family background measures evaluated at selected schooling levels. These results are described more fully below. Suffice it to note here, however, that for father's occupation and schooling and for family income there are no declines in the standard deviations over schooling levels. If anything, the dispersion increases, reinforcing the impact of declines in the variance of Q on changes in γ_t.

To summarize, γ_t, the effect of father's schooling (F) on son's mental ability (Q), is measured by the ratio of the covariance of F and Q to the variance of F. Over schooling levels, it is reasonable to assume that the covariance of F and Q will decline because at least some of the decline in the variance of Q produced by differential attrition is due to a decline in variance between levels of F. We have shown empirically that the variance of F does not decline over schooling levels. Together these facts imply that γ_t will decline steadily from the lowest levels of schooling to the highest.

Thus, the process of differential attrition itself is sufficient to weaken the covariance structure between a measured social background factor, father's schooling, and an unmeasured intervening factor, mental ability, and thereby to attenuate the observed reduced form effect of father's schooling over levels of schooling. This implies that the lower background status members of a cohort will improve their ability composition over levels of schooling more than their high status counterparts. Their relative gain in ability improves their relative chances for continuing to subsequent levels of schooling.

To confirm the above argument we present the regression of AFQT percentile on a set of social background variables, estimated for men attaining the six levels of schooling for which we will examine continuation decisions. Table 1 reports the results that are based on the 1964 veterans survey. Note first that the variance of AFQT declines monotonically from the earliest level of schooling to the latest, as one would expect from the advantage which higher ability men have in accumulating formal schooling. The regression results show that this decline in variance is in large measure a decline in variance that occurs between levels of the family background measures included in the equations. Both the R^2 and the coefficients for father's occupational SEI and education, farm background, and broken family show monotonic declines in absolute value from the earliest level of schooling to the latest.

The evidence in Table 1 supports the view that the effects of background on variables intervening between background and educational attainment--that is, the γ in the notation of the above argument--systematically decline over schooling levels. For this to imply corresponding declines in reduced form background effects it is necessary to assume that β_{t1} and β_{t2} in (2.1) do not change over schooling levels to nullify the effects of changes in γ_t. If they do change, then, by a similar argument, the changes can be related to the covariance structure among the independent parts of F and Q and other unmeasured variables intervening between F and Y. In this event (2.1) could be augmented with additional unobserved variables and the argument using the omitted variable formula extended.

The argument is also completely general with respect to the intervening variables considered. Thus, for example, we could

TABLE 1. Regression Analysis of Mental Ability (AFQT Percentile) on Social Background Characteristics at Selected Schooling Levels.

	All Men		Completes at Least 8th Grade		Completes at Least 9th Grade		Completes at Least 12th Grade		Completes at Least 13th Grade		Completes at Least 16th Grade	
	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$
Constant	30.160	5.52	32.600	5.94	34.430	6.14	42.750	7.15	54.180	5.59	67.010	4.51
FASEI	0.159	5.30	0.145	4.83	0.125	4.15	0.101	3.28	0.086	2.00	0.084	1.36
FARM	-3.263	-2.33	-3.109	-2.19	-2.173	-1.49	-1.414	-0.90	-0.414	-0.15	-1.043	-0.24
BROKEN	-5.608	-2.34	-5.367	-2.23	-5.069	-2.06	-3.288	-1.23	-2.175	-0.50	0.813	0.12
FED	1.054	5.58	1.003	5.33	0.884	4.69	0.711	3.70	0.425	1.55	0.447	1.18
SOUTH	-7.704	-6.16	-6.845	-5.42	-7.297	-5.68	-6.215	-4.56	-4.979	-2.36	-0.696	-0.22
R^2	0.0995		0.0869		0.0741		0.0526		0.0348		0.0299	
Var(AFQT)	618.8		598.1		578.0		525.4		447.4		389.3	
N	1889		1846		1758		1494		590		248	
S.E.E.	23.64		23.40		23.17		22.35		20.87		19.63	

NOTE: Estimates are based on 1964 sample of U.S. white male veteran population born 1930-1946.
Independent variables are: FASEI: Father's occupational Duncan socioeconomic index when respondent was 15; FARM: Respondent lived on a farm most of the time up to age 15; BROKEN: Absence of one or both parents from respondent's household when he was 15; FED: Father's grades of school completed; SOUTH: Respondent lived in South census region most of the time up to age 15.

replace or augment mental ability with peer aspirations. So long as all net effects are linear and there is a point at which the direct effects are constant over all levels of schooling, then the covariance between unmeasured influences and parental socioeconomic factors will decline, producing declines in the reduced form family socioeconomic effects on school continuation decisions.

On the other hand, to the extent that there are <u>not</u> monotonic declines in the effects of family socioeconomic status variables as schooling levels rise, this is evidence that the direct effects of some factors intervening between background and attainment may vary across levels of schooling. Sewell and Hauser (1975) find that perceived parental encouragement to attend college is an important variable transmitting the effects of mother's schooling and father's occupational status on son's post-secondary grades of schooling. Deviations from monotonicity in the relationship between the effects of mother's schooling or father's occupation on school continuation and schooling level would suggest that perceived parental encouragement has a weaker direct effect on school continuation in the earlier grades. There is no research that has employed a longitudinal design with repeated measures on such social psychological variables as parental encouragement. Thus there is no sound basis for hypothesizing departures from a monotonic decline in reduced form mother's schooling and father's occupation effects. Our detailed knowledge of the educational attainment process at the post-secondary level, however, is a basis for interpreting departures from monotonicity in the reduced form socioeconomic background effects.

A second source of nonmonotonicity in socioeconomic background effects is variation in the reliability of the parental socioeconomic variables. We pointed out above that our family income and paternal occupation measures pertain to when the respondent was sixteen years old. Featherman reports correlations for men's occupation and income over intervals as short as three years of approximately 0.6 (1971, p. 297). This implies that, whatever the reliability of the parental status measures when the respondent was actually sixteen, they are highly unreliable indicatiors of parental statuses when the respondent was younger and older than sixteen. The parental status measures, therefore, attain their maximum reliability as indicators of family conditions during the transition from high school attendance to high school graduation. Due to unreliability alone, the effects of parental income and paternal occupational status on that transition may be particularly large relative to the effects on other transitions. Overlaying the general pattern of declining effects over schooling levels, therefore, there may be differential attenuation of estimated effects produced by differential relevance of the measured background variables.

Our speculations on the schooling level variation in the pattern of parental socioeconomic effects on grade progression have relied on insights from previous research on the educational attainment process. The schooling level pattern of other social background effects in the model--number of siblings, broken family, southern birth, and farm origin--cannot be readily inferred from previous attainment process research. Studies of factors explaining the reduced form effects of family characteristics on educational attainment have typically not considered these variables (Sewell and Hauser, 1975) or have been less successful in accounting for their effects than for those of parental socioeconomic variables (for example, Featherman and Carter, 1976, p. 151). Table 1 showed that for three of the nonsocioeconomic variables, their effects on mental ability decline over schooling levels much as do the effects of paternal occupational and educational status. Insofar as ability and other intervening variables in the attainment process transmit family structure and place of origin effects on grade progression, the effects of the latter can be understood in much the same fashion as parental socioeconomic effects. But since this is not known, it is fruitful to consider mechanisms producing schooling level variation in these variables' effects in addition to the one already discussed.

Due to space limitations we shall not present detailed discussion of mechanisms responsible for variation over school transitions in the effects of characteristics of family structure or place of origin on grade progression. Suffice it to note that previous research provides ample basis for including these factors in the analysis (Blau and Duncan, 1967; Hauser and Featherman, 1976). Farm background is generally a disadvantage in accumulating formal schooling during the twentieth century inasmuch as farm labor has historically not required as much formal schooling as other occupations and farmbred sons are much more likely than other individuals to assume farm occupations. Southern origin is a disadvantage to formal school acquisition because of both the historically poorer quality of southern schools and the slower economic development of the southern region which has caused the south to lag the north in the demand for highly educated labor. Both one's number of siblings and the absence of one or more parents negatively affect educational attainment through their negative effect on the amount of monetary and social psychological parental resources experienced by the individual during the schooling years. There is, therefore, considerable reason to regard these factors as important determinants of formal school attainment. For more detailed discussion of variation in their effects over school transitions, see Mare (1977, ch. III).

3. RESULTS

This section reports our empirical findings. It begins with descriptive measures characterizing the distributions of family background factors at selected schooling levels. Then it turns to the basic logistic response model results from the OCG dataset on the effects of social background on grade progression. Finally, it reports supplementary results from the veterans' data set that provide more explicit support from our general argument.

Tables 2 and 3 describe the social background factors and the aggregate school continuation process over the schooling levels considered in the analysis. The means show that school attrition is far from random with respect to family origins. Increases in the means of father's occupation, family income, and mother's and father's grades of schooling over school transitions indicate that these variables have positive zero order effects on the likelihood of making the six schooling transitions. Similarly, declines over schooling levels in the mean number of siblings and percentages with broken families, farm background, and southern origin show the persistent negative effects of these variables on school continuation. Except for the percentages with broken families and southern birth, the means all change most between the high school graduation and college attendance levels. Although this implies that the background variables affect the likelihood of college attendance, it does not imply that their effects are stronger for this continuation decision than for any other. Rather it reflects that the greatest attrition occurs at this transition. The last column of Table 3 shows that the proportion of all men who attain each schooling level declines sharply from 72.5% for high school graduation to 39.8% for college attendance. Hence even relatively small social background effects on the decision to attend college given high school graduation are consistent with large changes in the means of the background variables.

For the continuously scaled social origin variables, the standard deviations and coefficients of skewness provide a fuller picture of the school attrition process. Were the parental socioeconomic distributions symmetric at the start of the schooling years, the positive effects of these variables on school continuation would ensure declines in their

TABLE 2. Means ($\bar{X}$), Standard Deviations (s), and Coefficients of Skewness (g)[a] for Social Background Variables at Selected Levels of Schooling.

	Father's Occupation			Family Income			Father's Schooling			Mother's Schooling			Number of Siblings		
Schooling Level	$\bar{X}$	s	g	$\bar{X}$	s	g	$\bar{X}$	s	g	$\bar{X}$	s	g	$\bar{X}$	s	g
School Entry (0)	31.6	23.3	.970	8359	6474	2.09	8.8	4.0	-.026	9.3	3.7	-.445	3.6	2.6	.647
Elementary School Completion (8)	32.7	23.5	.901	8689	6506	2.10	9.1	3.9	-.014	9.6	3.5	-.455	3.4	2.5	.728
High School Attendance (9)	33.5	23.6	.839	8915	6499	2.08	9.3	3.8	-.042	9.8	3.4	-.496	3.3	2.5	.793
High School Graduation (12)	35.8	24.2	.708	9513	6700	2.01	9.7	3.8	-.096	10.2	3.3	-.555	3.1	2.4	.928
College Attendance (13	42.1	25.2	.333	11100	7508	1.71	10.6	3.9	-.285	10.9	3.3	-.746	2.6	2.1	1.213
College Graduation (16)	46.4	25.7	.092	11890	7880	1.59	11.1	3.9	-.344	11.3	3.3	-.766	2.4	2.0	1.303

[a]Coefficient of skewness is $[\Sigma(X_i - \bar{X})^3]/ns^3$ where n is the number of observations.

NOTE: Estimates are based on 1973 sample of U.S. white male civilian non-institutional population born 1907-1951. For variable descriptions, see text.

TABLE 3. Percentages of Men with Broken Family, Farm Background and Southern Birth at Selected Levels of Schooling; Percentages at Each Level Continuing to the Subsequent Level; and Numbers at Each Level as a Percentage of All Men.

Schooling Level	Broken Family	Farm Background	Southern Birth	Percent[a] Continuing	Percent[a] Of All Men
School Entry (0)	10.1	21.5	27.6	93.4	100.0
Elementary School Completion (8)	9.7	19.2	25.8	93.1	93.4
High School Attendance (9)	9.5	17.1	26.1	83.4	87.0
High School Graduation (12)	8.9	15.8	24.7	54.9	72.5
College Attendance (13)	8.4	11.7	23.6	55.1	39.8
College Graduation (16)	7.5	9.8	23.1	50.0	21.9

[a]Excludes men at each level who are enrolled in school and have not continued to subsequent level.

NOTE: Estimates are based on 1973 sample of U.S. white male civilian non-institutional population born 1907-1951. For variable descriptions, see text.

standard deviations over schooling levels. Although the independent effects of other variables would retard the trend, each variable's net effect would render the population more homogeneous on that variable at successive schooling levels. For father's occupation and annual income, however, the standard deviations increase steadily, implying that their initial distributions are asymmetric. As Table 2 shows, the distributions are both positively skewed, conforming to the respective shapes of the occupational status and income distributions in the population. Over schooling levels, sons of low status fathers drop out in disproportionate numbers, making the father's status distributions for continuing sons more symmetric. Paradoxically, therefore, the net positive effects of father's occupation and family income, combined with their initial positive skewness, render the population more variable on these variables at higher levels of schooling than at lower levels.

The mother's schooling distribution, on the other hand, is negatively skewed for the population as a whole and, because of the positive net effect of this variable, becomes more skewed over schooling levels. Consequently, as intuition would suggest, the population becomes less variable with respect to mother's schooling. Similarly, the distribution of number of siblings becomes more positively skewed over schooling levels because persons from very large families are comparatively rare and, through the negative sibling effect on continuation, become even rarer at higher levels of schooling. Thus the population becomes more homogeneous with respect to number of siblings. Finally, note that the dispersion of father's schooling changes little over schooling levels and fails to decline above the high school level despite the initial symmetry of the distribution. This suggests that the independent effect of father's schooling is not very strong, particularly at the highest levels of schooling. To explore the multivariate process determining these sequences of social origin distributions we turn to the logistic response model estimates.

Table 4 reports the regressions of the log odds of school continuation on the eight background variables for six schooling levels. Each pair of columns presents the maximum likelihood parameter estimates for the effects of unit differences in the independent variables on the percentage difference in the odds of continuation. The second column presents the ratios of the coefficients to their standard errors. Assuming simple random sampling, these ratios have asymptotic standard normal distributions under the null hypothesis that their respective coefficients are zero. Below each column of coefficients is a measure of goodness of fit designated "R^2". It is analogous to the coefficient of determination in least squares regression and measures the proportion of the predictive error calculated under the null hypothesis that all coefficients are zero that is accounted for by the predictor variables (See Appendix B).

The "R^2" statistics show that the explanatory power of the social background variables declines sharply from the first school transition to the last. For elementary school completion the social background variables explain 27% of the predictive error; for high school completion given high school attendance they explain less than one half of this amount;

TABLE 4. **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. Estimates are based on 1973 sample of U.S. white male civilian non-institutional population born 1907-1951.
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 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 B.

and for college graduates, the influence of social origins on their decisions to pursue further schooling is virtually nil.

The effects of the separate parental socioeconomic characteristics also decline over schooling levels, although the declines are not invariably monotonic. A one-thousand-dollar difference in parental income corresponds to a 10% difference in the odds of completing elementary school, but less than a 5% difference in the odds of attending college given high school graduation. This indicates that those few persons who do not attain the minimal level of compulsory schooling come from the very poorest families; though income continues to exert an effect at the higher levels of schooling, other factors are evidently playing a larger role. Note that the only deviation from a monotonic decrease in family income effects occurs for the transition from high school attendance to high school graduation. This is consistent with the argument that reported annual family income at age 16 most reliably estimates income when the respondent was a high school student. Featherman's reported correlations of approximately 0.6 between income reports separated by a three-year period suggests that our family income measure is roughly 60% as reliable an indicator of income when the respondent was completing elementary school or making the transition into college as it is of income during the middle high school years. Although there are no established procedures for adjusting logistic response model parameter estimates for measurement error in the independent variables, differential reliability could easily account for the departure from monotonicity in the sequence of income effects.

Surprisingly, the family income effect declines to the point of being negative for the transition from college to post-college education. at this point the effect is small—a one-thousand-dollar increment in family income implies only a 1% reduction in the odds of continuation--but nonetheless statistically significant. At least two interpretations of this result are possible. One is that sons of the prosperous families are less likely to go beyond college because they need no further schooling to get lucrative employment. Within levels of father's occupational status and mother's schooling, heads of families with the highest incomes may be more likely to be self-employed or in managerial or craft positions where they can help their sons get desirable employment. A second interpretation is that the transition between completion of 16th grade and attending the 17th does not properly measure the transition from college to graduate level education. Specifically, respondents who take five or more years to complete an undergraduate program may report each of their undergraduate years as a grade of schooling, and hence claim to have attended 17 or more years without ever enrolling in an advanced degree program. Sons who take longest to complete college, moreover, may be those whose parents have the lowest incomes. It is beyond the scope of the present paper to present analysis investigating these two interpretations. Suffice it to note here that there does exist independent support for both interpretations and further analysis is necessary to rule out either of them.[4]

The coefficient estimates in Table 4 for the effects of mother's and father's grades of schooling decline from the lowest to the highest school transitions, although the declines are more precipitous for father's schooling than for mother's. An additional year of father's schooling improves the odds of elementary school completion by 12%, while an additional year of mother's schooling improves the odds by 17%. For high school graduates, however, the marginal impact of a grade of mother's schooling on the odds of college attendance is 10%, while the impact of father's schooling is only one half that large. (Note that, unlike the family income effect, parental schooling effects are not exceptionally large for the transition from high school attendance to high school graduation. This is consistent with the fact that parents' schooling is invariant throughout the respondent's schooling years, and thus a single pair of reports is equally reliable for all schooling levels.) Without measures on intervening variables it is difficult to explain differences in the rate of decline over son's schooling levels between mother's and father's schooling effects. The results, however, are consistent with the argument outlined above that parental encouragement to pursue further schooling may have a greater impact in the later schooling stages. Since mother's schooling affects higher educational attainment primarily through parental influence (Sewell and Hauser, 1975, pp. 97-101), the increased importance of parental influence may retard the decline in the reduced form mother's schooling effect produced by differential attrition. By contrast, father's schooling affects son's attainment primarily through mental ability (Sewell and Hauser, 1975, pp. 97-101). If ability is important throughout schooling, then the reduced form father's education effect will change mainly as a result of differential attrition, and therefore decline more rapidly than the mother's education effect. These speculations clearly go well beyond the analysis and rely heavily on the results of a single prior study. They nonetheless illustrate the type of explanation that will account for our findings.

Of the four parental status indicators father's occupational status shows the greatest departures from a monotonic decline in its effects. Table 4 shows that father's occupation has no significant effect on school continuation decisions up the the high school years, maximum impact on high school graduation where a one point increase in the socioeconomic index implies a 1.5% increase in the odds of graduation, and a gradually declining effect over the transitions at the post-secondary level. That the effect is largest at the transition from high school attendance to graduation again suggests that observed parameter differences are partly due to reliability differentials in the parental indicators over schooling levels. Occupation, like family income, refers to father's status when the respondent was 16 years old. Hence the smaller effects of father's occupation at transitions earlier and later than the middle high school years may again be an artifact of our failure to measure changes in father's occupational status throughout the sons's schooling years. The absence of father's occupation effects on the earliest continuation decisions suggests that factors intervening between father's occupation and continuation decisions do not have invariant effects over all schooling levels. Like mother's schooling, father's occupation affects attainment largely through parental encouragement (Sewell and Hauser, 1975, pp. 97-101). We have suggested that parental encouragement may have a greater impact on school continuation in the later transitions than the earlier ones. This may partially account for fluctuations in the father's occupational effects.

Our framework for interpreting schooling level variation in social background effects relies heavily upon the role of unobserved factors intervening between background and grade progression. One implication of this argument is, of course, that were the most important intervening variables included in our equations the observed net effects of social background factors would be approximately invariant over schooling levels. It is not possible to explore this conjecture throughly because adequate data are lacking. It is possible, however, to investigate the impact of taking account of mental ability, using the 1964 veterans data. Comparisons between estimated equations approximating those reported in Table 4 with and without a measure of ability should show that, when adjusted for ability, declines over schooling levels in reduced form parental socioeconomic effects are attenuated. This comparison is far from an optimal test. Earlier in the paper we enumerated limitations of the veterans data, including absence of key parental socioeconomic variables, inadequate measurement of school attendance, and ambiguous sample definition. In addition, the AFQT measure is causally ambiguous with respect to grade progression. Respondents took the AFQT when they had completed most of their formal schooling. This implies that the AFQT score is both an unreliable measure of ability possessed when making early school continuation decisions and is itself dependent on grade progression insofar as formal schooling enhances capacity to score highly on intelligence tests. It is difficult to ascertain the extent of measurement error and simultaneity bias in our results or its variation over estimated equations. On balance, it is informative to examine the overall pattern of coefficient results from the veterans data to see if they conform to our arguments; but not to place much weight on any particular coefficient estimates.

Table 5 reports the estimates for the logistic response model at six levels of schooling for equations estimated with and without AFQT. The first of each pair of equations shows that, as for the OCG estimates, both the overall effects of social background and the effects of parental socioeconomic statuses decline regularly from the earliest level of schooling to the latest. A year of father's schooling (FED), for example, implies a 19% difference in the respondent's odds of completing 8th grade, but only an 11% difference in his odds of completing a year of college given high school graduation. Note that, in contrast to the OCG results, the effect of father's occupational socioeconomic index (FASEI) is strongest at the earliest levels of schooling, undoubtedly due to the absence of parental income and mother's schooling in the equations. In the second equation of each pair, parental socioeconomic effects are estimated net of AFQT. As the "R^2" measures indicate, including AFQT enhances the predictive power of the equation at each level of schooling up to college, though it preserves the decline in predictive power over levels of schooling. The declines in net effects for father's occupation and schooling, however, are substantially attenuated. Up to the 5th transition, their effects are essentially constant, supporting the conjecture that much of their decline is due to a loosening covariance structure with unmeasured intervening variables. From the college level upward, including ability does not affect the declines in parental socioeconomic effects. This partially reflects the

TABLE 5. Coefficients Representing Effects of Social Background Factors and Mental Ability on School Continuation Decisions.

	Completes Elementary (0-8)				Completes First Year High School Given Completes Elementary (8-9)				Completes High School Given Completes First Year High School (9-12)			
	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$	$\hat{\beta}$	$\hat{\beta}/S.E.(\hat{\beta})$
Constant	0.1219	0.08	1.8180	1.19	-1.2080	-1.07	-0.3207	-0.27	1.1070	1.69	2.3110	3.25
FASEI	0.0418	2.76	0.0269	1.77	0.4158	3.76	0.0348	3.09	0.0256	5.17	0.2228	4.34
FED	0.1917	2.25	0.1007	1.12	0.1622	0.30	0.1116	1.95	0.1236	4.34	0.0965	3.24
BROKEN	-0.4628	-0.74	-0.0064	-0.01	-0.2697	-0.56	0.1053	0.21	-0.5950	-2.15	-0.4292	-1.45
FARM	-0.0421	-0.12	0.3549	0.97	-0.6297	-2.55	-0.4896	-1.88	-0.0903	-0.54	0.0314	0.18
SOUTH	-1.2650	-3.75	-0.9649	-2.66	-0.0496	-0.20	0.3160	1.18	-0.2806	-1.81	-0.0067	-0.04
AFQT			0.0970	6.49			0.0512	7.40			0.0376	10.56
"R^2"	0.122		0.321		0.093		0.202		0.060		0.140	
N	1889				1846				1758			

[continued]

TABLE 5. Continued

	Completes First Year College Given Completes High School (12-13)				Completes College Given Completes First Year College (13-16)				Completes First Year 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	1.9410	3.38	3.2510	5.25	0.4264	0.45	1.2480	1.27	0.8847	0.55	0.9510	0.57
FASEI	0.0214	7.13	0.0206	6.65	0.1362	3.25	0.0127	2.98	-0.0003	-0.04	-0.0003	-0.06
FED	0.1139	6.19	0.1039	5.44	-0.0101	-0.38	-0.0167	-0.62	-0.0160	-0.41	-0.0165	-0.42
BROKEN	-0.3037	-1.19	-0.2693	-1.01	0.2463	0.58	0.2831	0.66	-0.3242	-0.45	-0.3244	-0.45
FARM	-0.3618	-2.40	-0.3674	-2.35	0.1214	0.45	0.1290	0.47	-0.3012	-0.65	-0.3001	-0.65
SOUTH	0.0071	0.05	0.1773	1.30	-0.1743	-0.84	-0.1030	-0.49	-0.4563	-1.35	-0.4554	-1.35
AFQT			0.0263	9.88			0.0149	3.58			0.0010	0.15
"R^2"	0.066		0.104		0.012		0.024		0.006		0.006	
N	1494				590				248			

NOTE: Dependent variables are the log odds of continuing from one level of schooling to the next. Estimates are based on 1964 sample of U.S. white male veteran population born 1930-1946.
Independent variables are: FASEI: Father's occupational Duncan socioeconomic index when respondent was 15; FARM: Respondent lived on a farm most of the time up to age 15; BROKEN: Absence of one or both parents from respondent's household when he was 15; FED: Father's grades of school completed; SOUTH: Respondent lived in South census region most of the time up to age 15; AFQT: Percentile of score on Armed Forces Qulaifying Test. For definition of "R^2" see Appendix B.

modest role of social background in determining AFQT at the highest level of schooling (see Table 1).

Table 5 also shows that consideration of AFQT alone among known intervening variables provides an incomplete explanation of declines in reduced form parental socioeconomic effects. As noted, there remain strong declines in background effects at the college level, reflecting the limited relevance of background to ability at this level. Table 5 also shows, however, that AFQT effects themselves decline strongly from the earliest level of schooling to the latest. For example, a one percentile difference in AFQT implies almost a 10% difference in the odds of completing 8th grade, but only 2.5% difference in the odds of completing a year of college. Thus declines in the reduced form parental socioeconomic effects are due not only to a weakening effect of social background on ability, but also to a substantial weakening of ability effects themselves over schooling levels. A more complete explanation of the results in Table 4, therefore, would require further analysis of the covariance structure between ability and those factors intervening between ability and schooling.

4. CONCLUSION

The analysis of parental socioeconomic effects on school continuation decisions shows a pattern of effects mainly consistent with our initial argument. Both the overall predictive ability of social origins and separate parental socioeconomic effects decline over schooling levels. It is possible, therefore, to account for the schooling level pattern of reduced form parental effects quite well from a simple model relying on the implications of differential attrition. The school attrition process implies diminishing effects of social background factors on variables intervening between background and attainment, which produce declines in the reduced form effects. To characterize the general pattern of effects, therefore, it is largely unnecessary to argue the special relevance of socioeconomic background variables to particular school transitions.

On the other hand, there are important departures from monotonic and uniform declines in parental socioeconomic effects. There are significant father's occupational status effects only from the high school level upwards and a very slow decline in mother's schooling effects over schooling levels. By contrast, the impact of family income and father's schooling declines precipitously from the lowest to highest schooling levels. Available evidence on mechanisms intervening between background and higher educational attainment indicates that parental influence is particularly important in transmitting father's occupation and mother's education effects on attainment (Sewell and Hauser, 1975, pp. 99-100). Our findings suggest, therefore, that parental encouragement may have stronger effects on continuation decisions at higher than at lower levels of schooling, thereby offsetting the dampening impact of differential attrition on reduced form effects. As noted above, previous researchers have speculated that the strictly financial benefits of being raised in a family of higher socioeconomic status accrue in the pursuit of higher education, whereas nonfinancial benefits are more evenly distributed over the schooling process (Nam and Folger, 1965). Our analysis implies that the opposite may be closer to the truth: Differences among the pattern of parental status effects is presumptive evidence that the social psychological benefits of higher socioeconomic origins are most important at the highest schooling levels, while economic benefits afford greater advantages for grade progression in the pre-college years.

The analysis shows that nonmonotonic changes in parental socioeconomic effects also result from parental status reports not uniformly representing family conditions over the schooling process. Annual family income and father's occupation when the respondent was 16 years old have unusually strong effects on the school transition during which respondents typically have their 16th birthdays. These results illustrate the shortcomings of retrospective survey data for measuring the effects of social background conditions which vary significantly over the early life cycle. Although the limitations are very clear in the analysis of such age dependent, discrete events as school continuation decisions, they may also be important in the analysis of total grades of school completed. It is common, for example, to compare the educational attainment processes of blacks and whites, groups which have historically differed widely in their average attainment levels. Most black cohorts born during the first half of the twentieth century had average attainment levels well below high school graduation (Hauser and Featherman 1976, p. 110), implying that only small fractions of blacks remained in school through their mid-teenage years. White cohorts, by contrast, had relatively large fractions still in school during their late teens. Thus parental characteristics such as occupation or income referring to the mid-teenage years are potentially more relevant to the ultimate attainment levels for whites than for blacks. Quite apart from race differentials in response reliablility, therefore, black parental status reports are less reliable variables in educational attainment models because they are less representative of average family conditions respondents experienced during their schooling years.

The results of this paper may prove useful in understanding educational change. First, that social background effects vary considerably over schooling levels suggests that changing population composition on social background may play a stronger role in accounting for intercohort change in continuation rates at some levels of schooling than at others. In particular, there may be greater room for the role of aggregate market-level factors at higher levels of schooling where, cross-sectionally, social background effects are relatively weak. Second, at the outset we noted Hauser and Featherman's (1976) finding that some social background effects on highest grade completed decline gradually over cohorts born in the twentieth century. This decline may be due to secular increases in average levels of schooling. To wit, in more recent cohorts Hauser and Featherman's regression results may weight more heavily the variability in rates of continuation at higher levels of schooling than in earlier cohorts. Since background effects on the higher levels of schooling are relatively weak, this may produce net declines in the overall effects of background on total educational attainment. Finally, the processes inducing cross-sectional variation in background effects on grade progression over schooling levels may also induce intercohort variation in background effects at a given level of schooling. Intercohort differences in attrition rates suggest that there will be intercohort differences in the covariance of family background and factors intervening between background and grade progression. This would imply significant intercohort differences in reduced form family background effects. In summary, cross-sectional variation in inequality of educational opportunity may be the kernal to understanding a number of facets of changes in the level and distribution of formal schooling.[5]

APPENDIX A: SPECIFICATION ERROR IN LOGISTIC RESPONSE MODELS ESTIMATED BY MAXIMUM LIKELIHOOD

The paper argues that declines in parental status effects on unmeasured intervening variables produce declines in reduced form parental status effects on continuation decisions. This assumes that the omitted variable formula for equations estimated by ordinary least squares holds for logistic response equations estimated by maximum likelihood. The following shows that this is true in large samples.

A.1 Ordinary Least Squares (OLS)

Consider the model:

$$y_1 = X\beta_1 + Y_2\beta_2 + u$$

$$Y_2 = X\Gamma + V$$

where y_1 is an (n x 1) vector of observations on a scaled variable, X is an (n x p) matrix of observations on p exogenous variables, Y_2 is an (n x q) matrix of observations on q scaled endogenous variables, β_1, β_2, and Γ are coefficient matrices of orders (p x 1), (q x 1), and (p x q) respectively, and u and V are matrices of stochastic disturbances of orders (n x 1) and (n x q) respectively. Assume that within columns u and V are random, and that u and V are mutually independent. Suppose we have observations on y_1 and X, but not on Y_2, and estimate the equation

$$y_1 = X\beta_1^* + u^*$$

by OLS. Then

$$E(\hat{\beta}_1^*) = (X'X)^{-1}X'X\beta_1 + (X'X)^{-1}X'E(Y_2)\beta_2 \tag{A.1}$$

$$= \beta_1 + \Gamma\beta_2$$

where $\hat{\beta}_1^*$ is the OLS estimator for β_1^* (for example, Theil 1971, pp. 548-549).

A.2 Logistic Response Model

Now let y_1 be a binary response variable taking the values 1 or 0. Then we specify the following model:

$$L = X\lambda_1 + Y_2\lambda_2 \tag{A.2}$$

$$Y_2 = X\Gamma + V \tag{A.3}$$

where

$$L = \log_e\left[\frac{p(y_1=1)}{1 - p(y_1=1)}\right]$$

is an (n x 1) vector, λ_1 and λ_2 are coefficient vectors of orders (p x 1) and (q x 1) respectively, and the remaining notation is as defined above. Assume that within columns the elements of V are random. Suppose once again that we lack observations on Y_2 and estimate the equation

$$L = X\lambda_1^* \tag{A.4}$$

Since L is not observable, we estimate (A.4) by maximum likelihood methods (Cox 1970, pp. 87-90; Nerlove and Press 1973).

For the purpose of interpreting $\hat{\lambda}_1^*$, the estimator of λ_1^*, we examine its relationship to λ_1 and λ_2 and their maximum likelihood estimators, say $\hat{\lambda}_1$ and $\hat{\lambda}_2$. When (A.2) is estimated by maximum likelihood, the estimator $\begin{pmatrix}\hat{\lambda}_1\\ \hat{\lambda}_2\end{pmatrix}$ has an asymptotic multivariate normal distribution with mean vector $\begin{pmatrix}\lambda_1\\ \lambda_2\end{pmatrix}$ and covariance matrix H^{-1}, where H is the matrix of expectations of minus the second partial derivatives of the log likelihood function with respect to $\begin{pmatrix}\lambda_1\\ \lambda_2\end{pmatrix}$. Then the distribution of $\hat{\lambda}_1^*$ is the conditional distribution of $\hat{\lambda}_1$ given $\hat{\lambda}_2$. If we partition H^{-1} to be conformable with $\begin{pmatrix}\lambda_1\\ \lambda_2\end{pmatrix}$, say

$$H^{-1} = \begin{pmatrix} C_{11} & C_{12} \\ C_{21} & C_{22} \end{pmatrix}, \qquad \text{(A.5)}$$

then $\hat{\lambda}_1^*$ is asymptotically multivariate normal with mean vector

$$E(\hat{\lambda}_1 - C_{12}C_{22}^{-1}\hat{\lambda}_2) = \lambda_1 - C_{12}^{-1}C_{22}\lambda_2$$

and covariance matrix

$$C_{11} - C_{12}C_{22}^{-1}C_{21}$$

(DuMouchel, 1976:10-11). Thus to show that the omitted variable formula (A.1) holds for the model given by (A.2) and (A.3), it suffices to show that

$$-C_{12}C_{22}^{-1} = \Gamma \quad .$$

We proceed by examining a special case of the model given by (A.2) and (A.3), that is, where X and Y_2 each have a single column. The analysis generalizes to the case where these matrices have arbitrary dimensions. Let the columns be designated by x and y_2 respectively. Assume, without loss of generality, that x and y_2 are measured as deviations from their means. Then the model becomes

$$L_i = \lambda_1 x_i + \lambda_2 y_{2i} \tag{A.6}$$

$$y_{2i} = \gamma x_i + v_i \quad . \tag{A.7}$$

where i denotes the ith individual. Equation (A.6) implies

$$p_i = \exp(\lambda_1 x_i + \lambda_2 y_{2i})/[1 + \exp(\lambda x_i + \lambda_2 y_{2i})] \tag{A.8}$$

and

$$1 - p_i = \frac{1}{1 + \exp(\lambda_1 x_i + \lambda_2 y_{2i})} \tag{A.9}$$

where p_i is the probability that $y_{1i} = 1$. Then the log likelihood is

$$\ell(\lambda_1,\lambda_2) = \lambda_1 \sum_i x_i y_{1i} + \lambda_2 \sum_i y_{2i} y_{1i} - \sum_i \log_e [1 + \exp(\lambda_1 x_i + \lambda_2 y_{2i})]$$

(Cox 1970, p. 87). So we have

$$H = E\begin{pmatrix} -\dfrac{\partial^2 \ell(\lambda_1,\lambda_2)}{\partial\lambda_1^2} & -\dfrac{\partial^2 \ell(\lambda_1,\lambda_2)}{\partial\lambda_1\ \partial\lambda_2} \\ -\dfrac{\partial^2 \ell(\lambda_1,\lambda_2)}{\partial\lambda_1\ \partial\lambda_2} & -\dfrac{\partial^2 \ell(\lambda_1,\lambda_2)}{\partial\lambda_2^2} \end{pmatrix}$$

$$= E\begin{pmatrix} -\sum_i \dfrac{x_i^2 \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} & \sum_i \dfrac{x_i y_{2i} \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} \\ -\sum_i \dfrac{x_i y_{2i} \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} & -\sum_i \dfrac{y_{2i}^2 \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} \end{pmatrix}$$

Therefore,

$$H^{-1} = \frac{1}{|H|}\begin{pmatrix} -E\sum_i \dfrac{y_{2i}^2 \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} & E\sum_i \dfrac{x_i y_{2i} \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} \\ E\sum_i \dfrac{x_i y_{2i} \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} & -E\sum_i \dfrac{x_i^2 \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2} \end{pmatrix}$$

which, along with (A.8), implies

$$-C_{12}C_{22}^{-1} = \frac{E\left\{\sum_i \dfrac{x_i y_{2i} \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2}\right\}}{E\left\{\sum_i \dfrac{x_i^2 \exp(\lambda_1 x_i + \lambda_2 y_{2i})}{[1+\exp(\lambda_1 x_i + \lambda_2 y_{2i})]^2}\right\}} .$$

But, from (A.8) and (A.9), this is simply

$$-C_{12}C_{22}^{-1} = \frac{E[\sum_i p_i(1 - p_i)x_i y_{2i}]}{\sum_i p_i(1 - p_i)x_i^2} \tag{A.10}$$

$$= E(\hat{\gamma}) \quad .$$

So $-C_{12}C_{22}^{-1}$ is the expectation of $\tilde{\gamma}$, a weighted least squares (WLS) estimator of γ in (A.7), where the weights are the expected variances of y_1 at each level of x. Now $\tilde{\gamma}$ will not, in general, be an efficient estimator of γ since, under the assumptions of the model, the OLS estimator will be efficient. The WLS estimator, however, is unbiased. Thus

$$E(\tilde{\lambda}_1^*) = \lambda_1 + C_{12}C_{22}^{-1}\lambda_2 \tag{A.11}$$

$$= \lambda_1 + [E(\tilde{\gamma})]\lambda_2$$

$$= \lambda_1 + \gamma\lambda_2$$

which is isomorphic to the corresponding formula (A.1) for OLS.

In the general case of model (A.2) and (A.3), (A.10) becomes

$$-C_{12}C_{22}^{-1} = E[(X'WX)^{-1}X'WY_2]$$

$$= E(\tilde{\Gamma})$$

where W is an (n x n) diagonal matrix with ith diagonal element equal to $p_i(1 - p_i)$. So (A.11) becomes

$$E(\hat{\lambda}_1^*) = \lambda_1 + [E(\tilde{\Gamma})]\lambda_2$$

$$= \lambda_1 + \Gamma\lambda_2$$

which is isomorphic to the corresponding formula (A.1) for OLS.

APPENDIX B

This measure of fit is due to DuMouchel (1976). Reexpress equation (2.1) as

$$\log_e\left[\frac{p(y_{ij}=1)}{1 - p(y_{ij}=1)}\right] = \beta_{jo} + \Sigma\,\beta_{jk}X_{ijk}$$

where y_{ij} is a binary response variable taking the values 1 or 0. Define the predictive error of the model under the null hypothesis that $\beta_{jk} = 0$ for all k as

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

and the predictive error under the estimated model as

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

where p is the overall probability that y = 1 and X_{ij} is a (1 x K) vector of values on the K predictor variables for the <u>ith</u> individual. Then

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

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

FOOTNOTES

1. Equation (2.4) assumes that the omitted variable formula for ordinary least squares estimators holds for logistic response models estimated by maximum likelihood. For a proof of this, see Appendix A.

2. For a partial statement of this conjecture, see Hauser (1976, p. 920).

3. At each schooling level, persons enrolled in school on the survey date who had not made the transition to the next schooling level were excluded from the analysis. To reduce computation costs, the equations for the first four transitions were estimated from random samples of the total data set. The approximate sampling fractions are presented at the base of each pair of columns.

4. That there may be a genuine negative parental income effect on son's schooling is suggested by Sewell and Hauser's finding of a significant positive net family income effect on son's earnings net of son's schooling and other social background and intervening factors, but no significant net effects for other parental socioeconomic characteristics (1975, pp. 98-100). This suggests that, within levels of other parental statuses, family income indexes parents' ability to benefit directly sons' earnings attainment. Parents may be able to aid their sons, for example, when they are in craft occupations in which apprenticeships are allocated through family connections; when they are in upper managerial positions with control over personnel decisions; or when they own farms or businesses and can either bequeath the establishment or provide lucrative positions within it for their heirs. Given such mechanisms, sons from the poorest families will typically find professional education their most promising avenue of upward mobility.

That attendance in the 17th grade does not adequately measure post-college level enrollment is suggested by the results of re-estimating the final equation in Table 4 for the transition from 16th to 18th grade rather than from 16th to 17th grade. In that equation the coefficient for parental income is insignificant and virtually zero. Since persons reporting attendance in the 18th year of schooling contain relatively few persons who have not attended some post-college schooling, the transition from 16th to 18th grade may more accurately measure the actual transition between college and post-college education. That there is no detectable negative parental income effect for this transition suggests that the results for the final equation reported in Table 4 may in fact result from the ambiguous educational status of persons who report attending a 17th grade of schooling.

5. For further investigation of these issues, see Mare (1977).

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