DOCUMENT RESUME

ED 269 572 CE 044 275

AUTHOR	Hotchkiss, Lawrence
TITLE	Effects of Schooling on Cognitive, Attitudinal, and Behavioral Outcomes. Technical Report.
INSTITUTION	Ohio State Univ., Columbus. National Center for Research in Vocational Education.
SPONS AGENCY	National Inst. of Education (ED), Washington, DC.
PUB DATE	84
GRANT	NIE-G-83-0005-P-1
NOTE	166p.; A product of the School Effectiveness for Employability Project.
PUB TYPE	Reports - Research/Technical (143)
EDRS PRICE	MF01/PC07 Plus Postage.
DESCRIPTORS	*Academic Achievement; Academic Aspiration; *Dropouts; Educational Improvement; *Educational Practices; High Schools; High School Students; *Institutional Characteristics; Models; Occupational Aspiration; *Outcomes of Education; Research Methodology; Research Utilization; School Effectiveness; Socioeconomic Background; *Student Characteristics; *Track System (Education); Values; Vocational Education
IDENTIFIERS	High School and Beyond (NCES)

ABSTRACT

This report attempts to answer criticisms that have been leveled against existing research on effective schooling. The research reported has three important features: (1) it is based on a major national survey--High School and Beyond (HSB)--with longitudinal information on each respondent; (2) measures are not restricted to verbal and quantitative test scores; and (3) dynamic modeling with differential equations is applied to guide the statistical analyses. Ten outcomes are examined by the study: verbal test, quantitative test, science test, civics test, educational expectation, occupational expectation, self-esteem, locus of control, work values, and deportment. Four relatively distinct studies are presented in this report. The first examines differences among the 1,000 schools in the HSB sample on the average level of all 10 outcomes. Having found in the first study that different schools do produce differing levels on the 10 outcomes, the second study investigates school characteristics that may account for those differences. It finds that sector (private/public), school desegregation, and teacher labor relations have little or no effect on the outcomes, while demographic composition, student context, and policy variables have an important effect on test scores, career expectations, and/or self-esteem. The third study compares the effects of dropping out of school on quantitative and verbal test scores. This study concludes that the last two years of high school are effective in bolstering verbal and quantitative skills of most students and that black youth suffer more from dropping out of school. The fourth study examines effects of curriculum track (academic versus nonacademic) on all 10 outcomes, and finds that effects of tracking on all outcomes except work values are strong, although less so when endogenous variables are controlled. Recommendations based on the studies are presented. (KC)

EFFECTS OF SCHOOLING ON COGNITIVE, ATTITUDINAL, AND BEHAVIORAL OUTCOMES

Technical Report

Lawrence Hotchkiss

The National Center for Research in Vocational Education
The Ohio State University
1960 Kenny Road
Columbus, Ohio 43210-1090

1984

FUNDING INFORMATION

Project Title:	School Effectiveness for Employability
Grant Number:	NIE-G-83-0005, P-1
Project Number:	715903
Act Under Which Funds Were Administered:	P.L. 96-88
Source of Contract:	U.S. Department of Education National Institute of Education Washington, DC 20202
Project Officer:	Oliver Moles
Contractor:	The National Center for Research in Vocational Education The Ohio State University Columbus, OH 43210-1090
Executive Director:	Robert E. Taylor
Disclaimer:	This publication was prepared pursuant to a contract with the National Institute of Education, U.S. Department of Education. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their judgment in porfessional and technical matters. Points of view or opinions do not, therefore, necessarily represent official U.S. Department of Education position or policy.
Discrimination Prohibited:	Title VI of the Civil Rights Act of 1964 states: "No person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving federal financial assistance." Title IX of the Education Amendments of 1972 states: "No person in the United States shall, on the basis of sex, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any education program or activity receiving Federal financial assistance." Therefore, the Research Program on Employability, like every program or activity receiving financial assistance from the U.S. Department of Education, must be operated in compliance with these laws.

TABLE OF CONTENTS

LIST OF TABLES

List of Tables (continued)

FOREWORD

This report is part of a research program in progress at the National Center for Research in Vocational Education, the Ohio State University. This research program is designed to investigate the effects of school characteristics and processes on student outcomes related to employability after leaving school. The approach is to conduct statistical analyses with data from the High School and Beyond (HSB) survey as augmented by a supplemental survey of school staff in a subsample of schools contained in the HSB sample. The supplemental survey currently is in progress under the sponsorship of a consortium of NIE research centers led by the National Center for Research in Vocational Education. The supplemental survey is designed to obtain measurements of school goals and processes that the effective schools literature suggests are important in achieving the elusive goal of effective education. Members of the consortium are the following:

The National Center for Research in Vocational Education
The Ohio State University
Columbus, OH 43210

The Wisconsin Center for Education Research
The University of Wisconsin-Madison
School of Education
Madison, WI 53706

The Institute for Research in Educational Finance and Governance
Stanford University
Stanford, CA 94305

The Center for Educational Policy and Management
The University of Oregon
College of Education
Eugene, OR 97403

The Center for Social Organization of Schools
Johns Hopkins University
Baltimore, MD 21218

Since data collection associated with the supplemental HSB survey is not yet complete, this document makes use of the first two waves of HSB data collected from a sample of over 27,000 high school students who were sophomores in 1980. The focus of the analyses is on changes between the sophomore and senior year of the respondents in outcomes that are ostensibly related to employability after leaving school. These outcomes include test scores in verbal skills, mathematics, science, and civics, as well as measures of career expectations, self-esteem, locus of control, work attitudes, and deportment in school.

Appreciation should be expressed to the author of this report, Lawrence Hotchkiss, Project Director, National Center for Research in Vocational Education. Appreciation for helpful reviews of the report is extended to Donald

Mackenzie, Research Analyst, Maclin Information Services; Stewart Purkey, Wisconsin Center for Education Research; Jay Noel, Department of Education; Morgan Lewis, Research Specialist, National Center for Research in Vocational Education and Linda Lotto, Assistant Director, National Center for Research in Vocational Education; and to Suk Kang, Research Specialist, National Center for Research in Vocational Education. Thanks also are due to John Bishop, Associate Director, Research Division, National Center for Research in Vocational Education, for helpful comments and encouragement. Colleen Kinzelman typed the manuscript and Judy Balogh provided editorial assistance.

EXECUTIVE SUMMARY

Since publication of the Equal Educational Opportunity Report (EEOR) in 1966, the educational research community has witnessed an outpouring of quantitative work investigating issues related to effective schooling practices. The most controversial conclusion of the EEOR was that, after taking background characteristics of individual students into account, differences among schools in verbal achievement were negligible. This result was widely interpreted, at least initially, to mean that family background has a stronger effect on the cognitive achievements of youth than do schools. A storm of protest ensued. The EEOR was criticised for using the wrong statistical methods, for relying on cross-sectional rather than longitudinal data, for the low response rate of the sample, for the poor quality of most measures of school characteristics and school resources, for focusing exclusively on verbal test score as a measure of the outputs of schooling, and for failing to state explicitly the theory behind the statistical analyses.

A critical argument in this debate has been that comparisons of differences in mean cognitive achievement among schools to differences among youth from different home backgrounds are irrelevant to the issue of the relative impact of schooling and home environment on cognitive growth. The point is, that differences among schools could well be near zero if all schools were equally effective (or ineffective); hence, observation of differences among schools has no bearing on the issue. This argument has been made repeatedly in the literature, yet the fallout from the EEOR lingers.

A prodigious quantity of statistical analyses of the effects of schooling on learning has emerged since publication of the EEOR. This literature has addressed some of the criticisms directed at the EEOR--it has used more suitable statistical reporting methods, it has drawn on a variety of samples that help to answer problems of nonresponse and inadequate measurement in the EEOR, it has (frequently) stated explicit structural models of learning, and it has investigated school effects on a somewhat wider variety of outcomes than verbal test score. Yet, most of the critical questions regarding effective schools still have not been answered in a compelling fashion.

This report takes some important steps toward answering criticisms that have been leveled against existing research on effective schooling. Three features of the research reported here render it more authoritative than prior work. First, the present research is based on a major national survey (High School and Beyond) with longitudinal information on each respondent. Second, the outcome measures are not restricted to verbal and quantitative test scores. Finally, dynamic modeling with differential equations is applied to guide the statistical analyses.

The High School and Beyond (HSB) data consist of extensive survey information collected from students, formal tests of academic achievements, and survey data collected from high school administrators describing school characteristics. Two cohorts of high school students are included in the sample--students who were sophomores in 1980 and students who were seniors in 1980. The present report is based on the sophomore cohort of some 27,000 youth and makes use of information collected in the base year (1980) and at the first follow-up (1982) when members of the cohort would have been seniors if they had followed the modal pattern. The longitudinal character of the data permit examination of the impacts of schooling on changes in the outcome variables. Since the bulk of extant research is based on cross-sectional data, it is vunerable to the charge that observed differences among students exposed to differing educational experiences are differences that might have been present before the students were exposed. Hence, use of the longitudinal data marks an important improvement over past practices. The fact that the HSB comprise a major national data set of recent origin further enhances the value of the research reported here.

Ten outcomes are examined in this document. Four academic test scores are included--verbal test score, quantitative test score, science test score, and civics test score. Two measures of career expectations are included--educational expectation and occupational expectation. Three attitudinal variables also are studied--self esteem, locus of control (internal-external), and work values. Finally, an index of deportment in school is treated as a dependent variable. Since past research on effective schooling has concentrated on verbal and quantitative test scores, this expanded set of outcomes significantly broadens the scope of this type of research. The expanded set of outcomes reflects the view that schools strive to achieve multiple objectives. It also reflects the view that achieving one objective does not necessarily imply that other objectives are achieved, achieving one objective may even be determintal to achieving other objectives.

Since learning occurs as more or less continual change, and our measurements, at best, represent a sequence of widely spaced snapshots, it is important to develop an explicit conception of what we think occurs over time. Preliminary models of change using differential equations are proposed and tested in this report. These models serve as guides to statistical analyses and as aids in interpreting the results.

Four relatively distinct studies are presented in this report. The first examines differences among the some 1000 schools in the HSB sample on the average level of all ten outcomes--verbal test, quantitative test, science test, civics test, educational expectation, occupational expectation, self esteem, locus of control, work values, and the deportment index. The second study investigates effects of specific school characteristics on the same ten outcomes. The third study investigates an interaction model of the effects of dropping out of school on verbal and quantitative tests. The fourth study analyzes effects of curriculum track (academic vs. nonacademic) on the ten outcomes.

Recognizing that analysis of between-school differences is not pertinent to assessing the absolute level of effectiveness of <u>schooling</u> nor to the relative effectiveness of <u>schooling</u> and home background, this type of analysis is nevertheless important. It indicates whether two children of equal initial endowments attending different schools will experience unequal opportunity by virtue of the fact that they do attend different schools. As a nation concerned with equity and with the fullest possible development of human resources, we cannot afford to ignore differences in quality among schools. Examination of differences among schools also is important because it provides information about fruitful research strategy. If differences among schools are negligible, as has generally been concluded in the past, then study of between-school differences is not an efficient route for uncovering effective-schooling practices. On the other hand, if such differences are not negligible, then there is potentially much to be learned from studying them--especially since much more data describing school characteristics are available than data describing variations within schools.

The study of differences among schools in the ten outcomes is conceptually equivalent to comparing the average at first follow-up on each outcome calculated for each school to the average for every other school under controls for an extensive array of home background and personal characteristics and for the initial (base year) level of the outcome. Inclusion of controls for the initial level of each outcome variable is a critical part of the research that offsets it from most research of this type that has relied on cross-sectional differences.

The effects of attending different schools are summarized in a single statistic for each outcome--a partial correlation. For each outcome variable, the partial correlation reflecting effects of attending different schools is statistically significant and of moderate magnitude. Partial correlations summarizing the combined effects of background (parental status variables) and personal characteristics (race, gender, ethnicity) are somewhat larger than those associated with differences among schools, but the between-school correlations are large enough that they justify an important conclusion--the quality of schooling does differ from school to school. This conclusion contradicts widely held beliefs in the educational research community.

As part of the first study, a dynamic model of the effects of background, personal characteristics and between-school differences is proposed and subjected to tests. This model assists in interpreting results calcualted from longitudinal and cross-sectional data. Under the assumptions of the model, cross-sectional differences among schools and among youth of differing home backgrounds and personal characteristics reflect effects accumulated over a lifetime. Preliminary empirical results associated with this model reinforce the view that the effects of schooling increase with time relative to the effects of background and personal characteristics. More thorough tests of this interpretation, however, depend on use of more complex statistical methods and/or collection of more complete longitudinal data series.

Having found that different schools do produce differing levels on the ten outcomes, even with extensive controls included in the analyses, the second study investigates school characteristics that may account for those differences. Using the same set of controls applied in the first study, forty school characteristics are examined to determine to what extent they explain observed differences among schools. It is found that the combined impact of these forty school characteristics ranges from just over 50 to over 90 percent of the total between-school effects observed in the first study. The school characteristics tend to produce larger effects on the tests scores (except civics) and career expectations than on the other outcomes.

The school characteristics are classified into seven rough categories--sector (private-public), school desegregation, demographic composition, student context (e.g., percentage attending college), teacher labor relations, and policy variables (e.g., resources, teacher salaries, course offerings). It is found that--

- Sector has negligible effects on all ten outcomes.
- School desegregation has little, if any effects on the ten outcomes.
- Teacher labor relations have no effects on the ten outcomes.
- Demographic composition has substantial effects on test scores, career expectations, and self esteem.
- Student context has important effects on test scores and career expectations.
- Policy variables have important effects on test scores and career expectations.

These findings are important. They contradict the hotly debated conclusion (based on cross-sectional HSB data) of Coleman and his coauthors that private schools are more effective than public schools. They imply that some variables such as student subculture and school ethos that may be associated with demographic composition and student context are important in the schooling process. Finally, they show that some variables (mostly course offerings) under explicit policy control of educational administrators may influence outcomes of broad interest and importance. In agreement with past research, however. it is found that resource differences among schools do not influence the ten outcomes.

The third study compares the growth or decline in verbal and quantitative test scores of those who remain in school until they graduate to growth or decline in test scores of youth who drop out before completing high school. The study addresses the issue of whether the last two years of high school are effective in imparting academic knowledge; hence, it complements the focus of the first two studies which examine differences in effectiveness among different schools.

Two theoretical viewpoints are compared in the study of the effects of dropping out. The first viewpoint is formulated in a linear mdoel; the linear model expresses the hypothesis that learning "readiness" and exposure to new material can be added together to produce learning. In this view, readiness fully compensates for exposure and exposure fully compensates for readiness. The second theoretical viewpoint is that the effect of readiness on learning is stronger as exposure rate to new material increases, and the effect of increasing exposure is stronger for youth with higher learning readiness. This hypothesis is expressed by an interaction model. Empirical tests of these two theoretical orientations are conducted by adopting the following operational definitions of readiness and exposure: Readiness is indexed by sophomore year verbal and math test score, by background SES, and by personal characteristics. Exposure is indexed by drop-out status. Those remaining in school are assumed to have high exposure to academic knowledge. Those who drop out are assumed to have low exposure.

The linear (additive) model shows moderate effects of dropping out of school on both verbal and mathematics achievement. The interaction model shows substantially stronger effects than the linear model. Also in the interaction model the effects of dropping out are particularly deleterious for black youth. Given that the effect of dropping out of high school on academic achievement is negative, the linear model predicts that all youth are better off with respect to academic achievement if they remain in school. In contrast, the interaction model allows for the possibility that remaining in school is beneficial to some youth and not beneficial to others. Allowing for this possibility, the data still indicate that the majority of youth, especially black youth, learn more if they remain in school than if they drop out. In summary, three important conclusions are reinforced by the analysis--

- The last two years of high school are effective in bolstering verbal and quantitative skills of most students.
- Black youth suffer disproportionately from dropping out of school.
- A theoretical model expressing the idea that learning readiness increases the pace at which youth learn material to which they are exposed gives a better fit to the data than does the dominant linear model.

The fourth study examines effects of curriculum track (academic vs. nonacademic) on all ten outcomes. The idea is to find out whether membership in a nonacademic track has a negative effect on test scores, career expectations, self esteem, locus of control, and school deportment. Again, since selection into a nonacademic track is strongly affected by some of these outcomes--test scores and career expectations particularly--control for initial values of these variables while observing effects on change or on the values at time 2 is critical.

The study of curriculum and course work effects is conducted in three stages. In the first stage, self-reported curriculum track is used to construct a dummy variable indicating membership in the academic (or college preparatory) track. The track variable is entered on the right of equations including controls for background and lagged dependent variable. In stage two, controls for a large number of lagged indogenous variables are added to the equations. In the third stage, course work variables are added to the equations of stage two. Additionally, equations estimating effects of status background on track membership are examined. The main findings are as follows:

---

*Study of between-school differences is nevertheless important for reasons illustrated in chapters 4 and 5 of this report.

- With controls for exogenous background variables and lagged dependent variable, effect estimates of track on all 10 outcomes except work values are strong.

- When controls for the full complement of lagged endogenous variables are added to the equations of stage one, large reductions in the estimates of the effects of track are observed. Many of the formerly significant coefficients are reduced to nonsignificance.

- Even with controls for the full set of lagged endogenous variables, some important effects of track membership remain. Positive effects of membership in the academic track are relatively strong on educational expectation and math test score for both males and females.

- A portion of the total effects of track membership on the outcomes where significant coefficients appear is mediated by the pattern of course work taken in the last two years of high school. But the main pattern of effects observed prior to including controls for course work persist after these controls are added. The most important exception is that the total effect of track on educational expectations of females is largely mediated by course work.

- Total effects of family background on track membership are uniformly large, but race and ethnicity effects are absent. Much of the total effects of background are mediated by academic achievement, career expectations, and other attitudes. By a small margin, the most important components of the mediator variables consist of career expectations and other attitudes rather than academic achievement.

- Total effects of family income on membership in the academic track more than doubles during the last two years of high school.

- The effects of family income on membership in the academic track are larger for females than for males.

- Vocational courses tend to deflate test scores and career expectations, but not always. Business and office courses increase verbal test scores of females, increase work values of both sexes, increase educational and occupational expectations of males and decrease educational expectations of females.

- This pattern of effects tends to reinforce sex stereotyping of preparation for employment.

These findings are important for several reasons. First, they demonstrate the importance of including controls for many endogenous variables when estimating effects of curriculum track. Second, they suggest that track may be one mechanism by which socioeconomic background is transferred between generations--though the role of track in this regard is not exceptionally strong. Third, they show the key role of family income in the last two years of high school in determining whether a youth reports himself or herself to be in the academic curriculum track. Fourth, they reveal how patterns of sex stereotyping of preparation for employment are reinforced in high school.

A number of tentative policy conclusions are inferred from the findings. One of the most encouraging findings of this report is that school curriculum has the expected effects on learning. More academic course offerings raise test scores and educational expectations. Additionally, individuals who take academic courses raise their test scores more rapidly than those who don't. Consequently, assuming that an important goal of education is to improve academic achievcement as reflected in test scores, two implication of these findings are that--

- consideration should be given to increasing the number of academic courses offered in U.S. high schools, and

- students should be encouraged (required) to take academic courses.

These policy implications are in line with recent commission reports, such as the National Commission on Excellence, and agree with recent curriculum shifts in public high schools in the United States.

At the same time, we have not found strong effects of the length of the school day and school year on any of the 10 outcomes studied in this report. Since expanding the time in school is one of the most expensive educational reforms--

- the school day and school year probably should not be lengthened unless further evidence gives strong reason to do so.

Recent plans to encourage expansion of private schools (such as vouchers) also seem ill advised based on the evidence in this report. Sector, at best, has very small effects on the 10 outcomes studied here. In fact "other private schools" tend to reduce the "work ethic." Major expansion of the role of private schools in the United States has far-reaching implications and probably could not be reversed easily. Therefore--

- the role of private schools in U.S. education should remain relatively stable unless much stronger evidence of the advantages of private schooling than has been mustered to date is forthcoming.

The findings regarding the effects of dropping out of school on verbal and math test scores are clear--dropping out depresses them; this effect is more severe for blacks. These findings reinforce the view that--

- steps should be taken to discourage youth from leaving high school before they finish. Efforts to discourage blacks from leaving school early should be especially intense.

The findings regarding effects of curriculum tracking and course work related to track suggest that tracking may serve an undesirable selection function. Although the effects of track are not large, they are large enough that a review of both positive and negative functions should be undertaken. In the course of that review,

- Consideration should be given to abandoning the tracking system in high schools.

It must be recognized, of course, that abandoning the tracking system probably would not be easy to accomplish. Even if formal assignment to tracks were discontinued, many informal mechanisms for retaining the functions of tracking would persist. Students still would be likely to take, or be routed into, classes in a manner reflecting the formal tracking system that had just been repealed. Also, ability grouping of academic classes can easily be used to achieve results similar to those of curriculum tracking.

It must be emphasized that abandoning tracking does not mean that vocational courses should be discontinued or even reduced. Youth must be prepared for the world of work, and to the extent that vocational courses do so, they are important. Courses in clerical skills appear particularly important. They not only give women an advantage in the labor market, but they also tend to improve their verbal skills.

CHAPTER 1

INTRODUCTION

This report summarizes four empirical studies designed to help identify effective schooling practices. The primary motivation guiding the research is connected to preparing youth for productive employment after leaving school. The present report focuses on outcomes measured while respondents remain in high school, however. These outcomes are selected for their expected relationship to employment after leaving school. It must be noted that interest in employability development does not imply a narrow set of outcomes such as specific job skills or work attitudes. Rather, a broad net is cast. This net includes traditional outcomes--academic test scores. It also includes career expectations, self-esteem, work values, behavior in school, and sense-of-fate control.

The plea for improved knowledge of effective educational policies and practices has been made repeatedly and dramatically in recent years. The President's National Commission on Excellence in Education (1983) made the point in dramatic phases:

> If an unfriendly foreign power had attempted to impose on America the mediocre educational performance that exists today, we might well have viewed it as an act of war. As it stands, we have allowed this to happen to ourselves (p. 1).

A similar theme is evident in numerous other commission reports (e.g., Boyer 1983; Education Commission of the States 1983; National Science Board 1983). Most of these reports focus attention on academic education, but a similar call for improvement in vocational education is the major thesis of the National Research Council report Education for Tomorrow's Jobs (Sherman 1983). Employers echo these calls for improvement in education, indicating particularly strong need for improving basic skills and work-related attitudes of youth (Hollenbeck and Smith 1983; Center for Public Resources 1982).

The commission reports, particularly the Commission on Excellence, speak in strong terms--terms that overdramatize the problems in American education (Etzioni 1983; 1982; Peterson 1983). In fact, Peterson states that the commissions "make exaggerated claims on flimsy evidence, pontificate on matters about which there could scarcely be agreement, and make recommendations that either cost too much, cannot be implemented, or are too general to have any meaning" (p. 3).

Excessive rhetoric notwithstanding, the commission reports have identified symptoms of difficulties in U.S. schools. A number of academically oriented commentaries and research reports tend to concur, albeit in more sober terms than those used in the commission reports. Many of these papers advocate "no-nonsense" measures in schools that are intended to bring about improvement in academic achievement of students (see, for example, Clark, Lotto, and McCarthy 1980; Edmonds 1979; Mackenzie 1983). Yet, the research evidence on which such calls for action are based is inconclusive at best (Madaus, Airasian, and

Kelloghan 1980; Purkey and Smith 1982). Important issues regarding effects of more stringent course requirements, the impact of teacher training, the effects of class size, the influence of tracking, the relative importance of socioeconomic and school effects, to name only a few, remain unresolved.

The present report contains an account of research designed to help resolve selected issues in the debate about effective schooling. The focus of the research is much more restricted than is typical of policy documents such as National commission reports and studies such as Goodlad's A Place Called School (1983). Many issues addressed in this report are nevertheless of longstanding importance to educational policy. Although no single research study can yield definitive answers to questions such as the effect of tracking on student performance, important information that is pertinent to policy considerations does emerge from the analyses. These policy implications are laid out explicitly, albeit with full cognizance of the necessarily tentative nature of the findings. Policy by its very nature must be formulated in the absence of complete information. Results of the present research should be viewed in this light--as partial pieces of information to be combined with what is already known as part of the process of formulating educational policies and practices.

Overview

The studies contained in this report analyze longitudinal data from a major National data set--the High School and Beyond (HSB). Changes between the sophomore and senior year in high school for 10 outcome variables are examined for a sample of some 27,000 youth. The 10 outcomes are: verbal test score, math test score, science test score, civics test score, educational expectation, occupational expectation, self-esteem, locus of control, work values, and school deportment.

Four specific studies are presented in relatively self-contained chapters. The first study (chapter 4) examines differences in the average changes of these 10 outcomes among schools, using a number of controls for personal characteristics (race and gender), socioeconomic background, and the sophomore value of the dependent variable. The purpose of this analysis is to determine whether different schools are more or less effective in generating changes in the 10 outcomes. There are at least two reasons why this analysis is important. First, if all schools are about equally effective, then public policy need not be concerned with which students attend which schools. On the other hand, if schools do vary substantially in their quality, it becomes an important equity issue as to how students are distributed among schools. Also, as a matter of fully developing the potential of our citizens, educational policy should attend to upgrading schools that are performing below the norm.

The second reason why study of overall school differences is important relates to research strategy. If there are no differences in the performance of students in different schools once student characteristics are taken into account, then there is nothing to be learned from studies that attempt to identify particular school characteristics (such as number of students) with effective schooling. On the other hand, if differences among schools do, in fact, occur, then it is worthwhile to investigate what school characteristics or processes account for those differences.

Having found in the first study fairly substantial differences among schools in average growth rates for the 10 outcomes, the second study (chapter 5) takes the next logical step and asks the question: What specific characteristics of schools are associated with high and low rates of growth? A large number of specific variables describing schools are used in the analyses, including school policy variables, demographic composition and size, school desegregation, private or public ownership, and student composition variables such as percentage attending college or in the vocational track.

The third study (chapter 6) investigates the effects of dropping out of high school between the sophomore and senior year on verbal and math test scores. The HSB data afford an unusual opportunity in this regard because they contain test scores both before and after a youth dropped out of school. Thus, much better control for predispositions that might influence both test scores and dropping out are available in the HSB than in most data sets. This chapter tests a model of learning in which learning is depicted as a result of the product of exposure to material and "readiness." The findings are important because they help to dispel the notion that schools are not effective and because they demonstrate empirically that the interactive or product model of learning is superior to the more usual linear model.

The fourth study (chapter 7) examines the influence of being in a nonacademic track on all 10 outcomes. It is found that those in nonacademic tracks tend to show less growth on test scores, have lower career expectations, and reduce their sense of control over their own future. These results hold under control for a number of lagged endogenous variables and years of course work in various academic and vocational subjects. But effect estimates are reduced substantially with the added controls. Strong enough effects remain, however, to raise important questions about the functions of tracking.

The second chapter in this document reviews the literature related to effective schooling research. The third chapter summarizes the methodology. In order to make each of the substantive chapters (chapters 4 through 7) relatively self-contained, selected aspects of these 2 chapters are summarized in the substantive chapters. Chapters 2 and 3 give more complete and integrated versions of their topics than are contained in later chapters. The final chapter summarizes the findings, identifies some next steps in the research, and discusses policy implications.

Conceptual Framework

The four studies reported here are part of a broader program of research on development of employability skills. Figure 1 displays the broad organizing framework of that program. It should be emphasized that the model in figure 1 is presented for its heuristic value; it is not intended to represent details of the relationships among all the variables listed. The four studies in this document examine effects of school characteristic and schooling on variables labeled "in-school student outcomes."

The box labeled "control variables" contains variables such as socio-economic descriptors of family origin, race, gender, and ethnicity. The input-output school variables include factors such as expenditures, facilities, and teacher training. The school process variables include aspects of schooling such as curriculum and course work taken by students, disciplinary climate, and teacher expectations of students. The box labeled "in-school student outcomes" contains variables such as work attitudes, deportment in school, career aspirations and expectations, and student test scores. The boxes under post-high school outcomes generally contain descriptors that suggest the type of variable included; for example, post-high school labor market outcomes include wage and hours per week of jobs held after leaving high school. The types of variables included as part of "attitudinal post-high school outcomes" include variables such as self esteem, locus of control, and educational aspirations measured at the first follow-up of the HSB.

The figure shows a basic assumption of the research: that schooling affects employment outcomes indirectly through impact on in-school student outcomes such as attitudes, behaviorial patterns, and cognitive skills. The model indicates that a variety of post-high school outcomes must be included in any study of educational preparation of youth for adult work roles. The fundamental idea here is that in-school student outcomes such as test scores are important because they affect post-high school employment outcomes. Post-high school labor market outcomes are closely related to other activities after high school; hence, postsecondary schooling, marriage and family variables, and key attitudes are included as part of the post-high school outcome groups. Finally, the presence of the control variables in the model serves as a reminder that analyses of school effects must include statistical controls for many variables whose omission could threaten the causal interpretations. It must be emphasized that the model, in the interest of simplicity, omits many possible relationships. For example, the in-school student outcomes affect each other, though this fact is not expressed in the model.

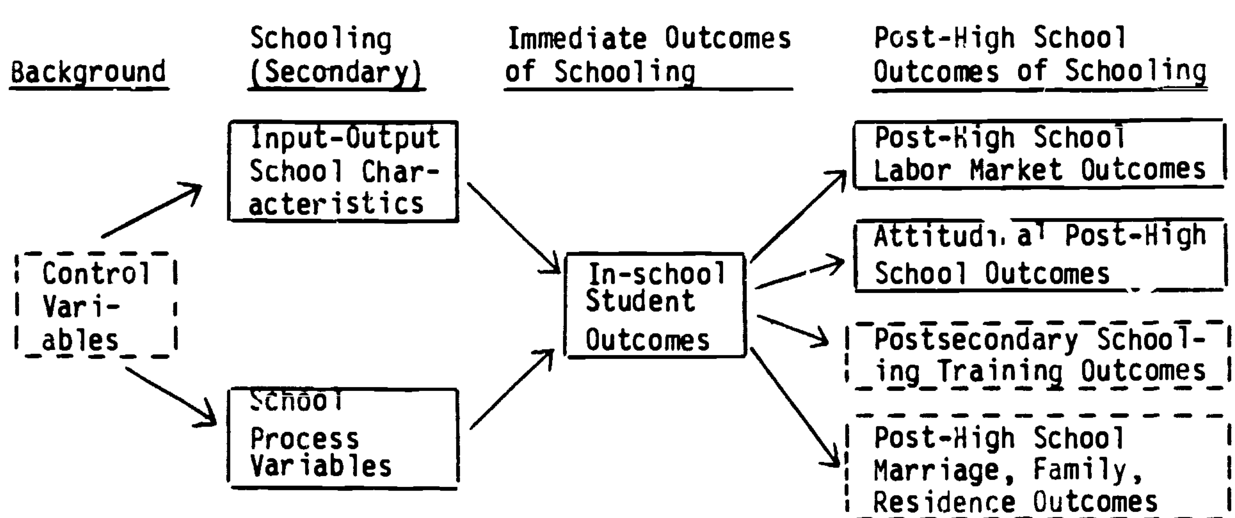


Figure 1. Schematic model of schooling effects on employability of youth

CHAPTER 2

REVIEW OF PAST RESEARCH

The Equal Educational Opportunity Report

The Equal Educational Opportunity Report (EEOR) (Coleman et al. 1966) launched an era of research in which large-scale survey data have been used in attempts to identify between-school differences in student achievements that cannot be attributed to socioeconomic background and personal characteristics of the students. The primary dependent variables in these input-output studies have been standardized test scores reflecting level of verbal and mathematics skills, although other dependent variables have also been studied (e.g., Hauser, Sewell, and Alwin 1975; Jencks and Brown 1977).

The major conclusion offered in the EEOR is that differences among schools account for relatively little of the variance in the verbal test scores of U.S. elementary and high school students. In the absence of any controls for socioeconomic background, the proportion of total variance between schools in verbal achievement ranged from about 5 percent to about 35 percent in the data analyzed by Coleman in the Equal Educational Opportunity Survey (EEOS).*

Between school variation was found to be substantially less among whites and blacks than among other subgroups, less in the North than in the South, and less among senior high school students than among elementary students. Northern whites exhibited the least between-school variance--7 to 11 percent. Relatively high between-school variance occurred among first graders; this observation was interpreted to imply that between-school differences occur at intake rather than being produced by schooling experiences.

Perhaps the most striking finding reported by Coleman and his colleagues is that school characteristics have negligible effects on verbal test scores once individual background characteristics are controlled. School characteristics such as per-pupil expenditure, student-teacher ratio, physical facilities, indicators of teacher quality (aggregated to the school level), curriculum, and teacher attitudes (aggregated to the school level) displayed negligible effects on explained variance in verbal test scores. On the other hand, especially among minority youth, characteristics of the student population at each school and teacher characteristics accounted for a modest amount of variance in verbal test scores, after controls for individual background.

Racial composition of schools was found to be an important predictor of test scores, but this effect was found to be due largely to school aggregate educational plans of students. This finding was interpreted as having important implications for the manner in which school "social systems" comprise self-perpetuating influences on their students. Teacher education and teacher verbal ability showed strong effects on test scores of minorities but not so strong effects on whites.

---

*The test was labeled an ability test by those who constructed it, but Coleman et al. argue that it measures achievement.

Students' own sense of control over their environment for all racial/ethnic groups except whites and Asians exhibited strong effects on achievement. Self-concept had a stronger effect for whites and Asians.

The Coleman report raised a storm of controversy, for its findings contradicted many cherished beliefs of the time when it was released. Cain and Watts (1970), for example, summarize a widespread reaction; they say that the Coleman report

> presents a ver dismal picture of the effectiveness of our educational system in securing equal opportunities for all our citizens. Looking at educational outcomes for children from different backgrounds, one finds wide discrepancies which the American dream has assumed capable of elimination through the public school system. (p. 228)

Within the first few years following release of the report, a number of salient criticisms were leveled against it. These include the following:

- The report used the wrong statistics to assess effects of school characteristics. Estimates of unstandardized regression coefficients should have been used instead of increments to R-square (Aigner 1968; Bowles and Levin 1968; Cain and Watts 1968, 1970; Hanushek and Kain 1972; Wiley 1976).

- Analyses in the report should have been guided by an explicit structural model (Cain and Watts 1970), and, in particular, the structural form of the model should include provision for complementarity of educational inputs (Bowles and Levin 1968; Hanushek and Kain 1972).

- The cross-sectional data used by Coleman and his coauthors precluded adequate control for nonschool factors in cognitive achievement (Alexander, McPartland, and Cook 1981; Hanushek and Kain 1972; Smith 1972).

- The nonresponse rate in the EEOS was so high that it threatened the validity of the findings (Bowles and Levin 1968).

- The measures of school resources used were too crude, for example, indicating only presence or absence of a physics lab and nothing about its quality (Armor 1972; Bowles and Levin 1968; Hanushek and Kain 1972).

- School outputs besides standardized test scores should be considered (Armor 1972; Jencks and Brown 1975; Smith 1972).

- Aggregation of resources to the school level and in some cases to the district level (e.g., expenditures) fails to assess the exposure of individual students to those resources (Spady 1976).

Cain and Watts offer three main criticisms of the use of incremental R-squares in the EEOR. First, when regressors are correlated, allocation of explained variance to one or a set of regressors depends heavily on the order in which the regressors are entered into the regression equation. Cain and Watts object to procedures in the Coleman report whereby background characteristics of individual students are entered before school resources, thereby loading the dice against finding effects of school resources. Second, R-square increments do not yield estimates of expected changes in an outcome resulting from a change in the regressor or sets of regressors with which the increment is associated. Finally, numeric values of R-square are affected by the relative variances of variables included in a regression equation. With the "fundamental" effect parameters constant, R-square increments will differ considerably depending on the variances of the several variables under study. This observation also applies to standardized partial regression coefficients, since their values also depend on variance of variables included in a model.

Coleman (1970, 1972) responds to these criticisms on all counts. First, he defends entry of individual student background variables before school resources on the grounds that school resources do not cause parental characteristics of the students who attend the school, but background variables may affect the school a child attends and the financial resources allocated to the school. Second, while it is true that R-square values do not give good indication of expected changes in an outcome resulting from changing an input, current level of knowledge does not permit good estimates of this sort, irrespective of the statistic used. Further, comparisons among unstandardized coefficients are not meaningful unless all independent variables have the same metric. One cannot, for example, sensibly compare the effect on a child's cognitive achievement of an additional year of father's education to the effect of an increment of $1.00 in annual family income. Finally, Coleman shows that conclusions regarding relative importance of background and school resources remain intact when standardized partial regression coefficients are the basis of comparison. In fact, there is a very close empirical correlation between the partial correlation and partial standardized regression coefficients.

Other Input-Output Studies

The EEOS data have been subjected to many reanalyses since publication of the Coleman report (Armor 1972; Jencks 1972; Smith 1972). These analyses have changed the definition of key input variables and expanded the set of cognitive outcomes, corrected coding errors in the original EEOR (Smith 1972), used the school level of analysis rather than the individual level, made use of standardized and/or unstandardized partial regression coefficients and "commonality" analyses, and applied their analyses to various subsambles (by grade level and region) of the EEOS data. These reanalyses by and large do not challenge the main findings of the original report. For example, despite having found and corrected two "mechanical errors" in the variables used for the EEOR, Smith (1972) concludes that "In general, the results of the reexamination affirm and strengthen the overall conclusions of the [Coleman] Report . . ." (p. 311). Jencks (1972) concurs, and in an interesting footnote, attributes much of the dispute over the findings to interdisciplinary rivalries between sociologists and economists--Coleman is a sociologist, the detractors mostly economists.

In a lengthly review of effective schooling research, including coverage of the EEOR as well as other studies, Averch and colleagues (1972) agreed with the conclusion that school resources do not exhibit strong effects on the cognitive outcomes of students, but background factors do exhibit consistent impact. On the other hand, Averch and colleagues conclude that evidence regarding "student body" effects is not convincing.

Mayeske and colleagues (1972, 1973, 1975) undertook a major reanalysis of the EEOS data using a variance partitioning technique termed "commonality analysis." This method distributes explained variance of two independent variables (x,z) into three parts: one part uniquely due to x, one part uniquely due to z, and a part due jointly to x and z. This method has little to recommend it; it is based on a pure algebraic decomposition of variance and makes no use of a theoretic or causal framework within which an analysis is carried out. Nevertheless, Mayeske and colleagues do not challenge the finding of Coleman and colleagues that background contributes more to school achievement than do between-school differences in resources. They also find that attitudes such as parental educational expectations of their children, parental emphasis on learning, and locus of control are more important contributors to cognitive achievement than status background. Their use of commonality analysis lea them to conclude that it is impossible to separate much of the effects of background and/or race and ethnic group from effects of schools.

The EEOR and the beehive of controversy in its wake stimulated an outpouring of quantitative research designed to differentiate characteristics of effective schools from those of ineffective schools.* The phrase "schools don't make a difference" has frequently been used in a loose fashion to summarize the major findings of the EEOR. This characterization of the findings obviously is in error, and many scholars have taken strong exception to it (Alexander, McPartland, and Cook 1981; Armor 1972; Gilbert and Mosteller 1972; Heyns 1978; Madaus, Airasian, and Kellaghan 1981; Murnane 1975; Rutter et al. 1979; Wiley 1976). The obvious objection to concluding that schools don't make a difference based on comparisons of student differences between schools is that all schools undoubtedly are making a big difference in the cognitive achievements of their students; few youth would learn to read, write, do arithmetic, or do algebra unless they attended school. The fact that large differences in their achievements do not appear among schools implies that all

---

*Hanushek and Kain (1972) charge that the EEOR committed a major blunder when it attempted to analyze the relationships between school inputs and school outputs. They charge that the original congressional mandate was simply to document differences in school inputs, especially as they related to racial composition of schools. By stepping beyond the congressional mandate, Hanushek and Kain charge that the EEOR did a poor job both of documenting inequality of inputs and of analyzing effects of inputs on student cognitive achievement. Coleman (1972) responded that the EEOR changed the terms by which educational equality is assessed and stimulated an important shift in educational research. Subsequent events seem to have supported Coleman's contention.

schools do about equally well (poorly) in teaching cognitive skills. Bridge, Judd, and Moock (1979) summarize with a delightful analogy.

> Let us consider whether or not water has any effect on fish. To see the effect of water on fish, one would need to observe some in water and other fish completely out of water. The effects of small variations in water temperature or water salinity would tend to be small and difficult to measure, if indeed any effects existed. (p. 285)

This line of reasoning has generated a small number of studies that investigate the relationship between amount of time spent on schooling and achievement. Wiley (1976) and Wiley and Harnischfeger (1974) developed an involved statistical model for testing effects of hours in class per year on verbal and mathematics achievement. Using a special inner-city Detroit subsample of the EEOS, they show substantial impact of class hours on achievement. Karweit (1976) replicates the Wiley and Harnischfeger procedures on a larger EEOS subsample and reports results of a school-level analysis using Maryland state data. She finds smaller effects than Wiley and Harnischfeger but still reports substantial positive impact of school time on achievement. Barbara Heyns (1978) conducted a major study of effects of summer school on Atlanta youth. While she finds complex interactions by SES and race, her results support the view that quantity of schooling is an important factor in learning. Murnane (1975) presents interesting graphs showing a decline in test scores during summer months for elementary school children (who do not attend summer school).

Despite the obvious veracity of the argument that absence of between-school effects on achievement does not imply no effects of schooling and despite strongly worded arguments to the effect that research should concentrate on effects of the quantity of schooling (Wiley 1976), a massive body of research literature has accumulated since publication of the EEOR that examines between-school differences. Virtually every conceivable school characteristic contained in existing data sets has been used in one study or another to predict student achievement. Bridge, Judd, and Moock (1979) provide an extensive review of the input variables that have been used in these studies. They group the school inputs into three broad categories: (1) peer group characteristics, (2) teacher characteristics, and (3) school characteristics, including resources and facilities. Generally, these studies tend to support the conclusions of the EEOR that peer group and teacher characteristics are more important than school characteristics in determining school effects on student achievements.

Several criticisms may be leveled fairly against input-output studies of school effects. First, few of them have been based on longitudinal data; hence, they are open to the charge that between-school differences reflect student ability differences at intake (Alexander, McPartland, and Cook 1981; Heyns 1978; Murnane 1975; Rutter et al. 1979; Smith 1972; Spady 1976). Others argue that school effects are not secure until controlled field experiments are conducted (see especially Gilbert and Mosteller 1972). Restricting school outcomes to cognitive achievement has been routinely criticized (Alexander, McPartland, and Cook 1981; Jencks and Brown 1975; Smith 1972; Spady 1976). Tests also have been criticized on the grounds that they do not measure what is taught in school. If tests were designed to measure material appearing in course syllabi, more effects of schooling would be observed (Alexander, McPartland, and Cook 1981; Rutter et al. 1979). The input-output studies generally are atheoretical. They do not draw on social psychological theory of learning or even on common sense notions about the interaction between study time, learning readiness, and exposure rate (Walberg 1981). The probable specification error resulting from atheoretical application of the linear model to study school effects is taken up in some detail in the next section.

Schooling Process Research

A particularly important line of criticism of the input-output models argues that school characteristics other than objective inputs (e.g., expenditures) are the critical factors influencing student learning. Typically, these critics identify such "school process" variables as staff attitudes and school climate as crucial to the learning process. For example, Edmonds (1979) identifies five important school characteristics: (1) strong administrative leadership, (2) high expectation of students held by professional school staff (3) orderly atmosphere in the school, (4) emphasis on the importance of basic skills, and (5) frequent monitoring of student progress. These and similar conclusions have been reflected in a number of commentaries and research studies (e.g., Brookover et al. 1979; Clark, Lotto, and McCarthy 1980; Cohen 1981, 1982; Wellisch et al. 1978).

Purkey and Smith (1982) give a thorough review and evaluation of school process studies. They divide these studies into three groups: outlier studies, case studies, and program evaluation studies. The outlier studies apply regression methods to select particularly effective and ineffective schools. Effective schools are compared to ineffective schools using informal observational methods in order to identify school characteristics that differentiate between the two. It is inferred, either implicitly or explicitly, that changing ineffective schools to match the characteristics of effective schools will improve the quality of ineffective schools.

The outlier studies have not produced a generally agreed upon list of characteristics of effective schools, and, on occasion, findings of one study cannot be replicated in other studies. Nevertheless, these studies do suggest that good school discipline, high teacher expectations of students, and strong leadership are important components of effective schools.

Purkey and Smith indicate several criticisms of the outlier studies: samples have been small and unrepresentative, appropriate controls frequently have been missing from the regression equations used to identify effective and ineffective schools, aggregation of data to the school level probably is not defensible, effective or ineffective schools should be compared to average schools rather than to each other, and the definition of criteria for effective schools is subjective.

The case studies are similar to the outlier studies except that selection of schools for close scrutiny is done informally rather than by regression methods. Sometimes "exemplar" schools have been studied without any comparison schools. The obvious shortcoming of using only exemplar sample is noted by Purkey and Smith. Taken as a group, the case studies have compiled a long list of school characteristics associated with effective schooling, although there is not a general consensus on the contents of the list. The list includes features such as strong leadership, orderly atmosphere, high staff expectations of students, individualized instruction, use of phonics to teach reading, explicit goals, joint staff planning activities, teacher accountability, and emphasis on complex "highe order skills" in reading instruction.

Many of the difficulties of case studies parallel those of outlier studies, including informal observation methods that are difficult to replicate, small unrepresentative samples, and subjective criteria for defining effective instruction.

The program evaluation studies apply comparatively rigorous methods to determine the effectiveness of intact educational programs that often are not coincident with a particular school. In spite of the different approach of the evaluation studies, their conclusions tend to overlap with some of the results of the outlier and case studies. Characteristics of effective programs identified by these studies include: high teacher expectations of students, orderly classrooms, high parent involvement, inservice training for teachers, and strong but nonauthoritarian leadership.

Eight school characteristics associated with effective schooling are repeated in two or more of the studies reviewed by Purkey and Smith. These are as follows:

- Effective administrative leadership
- High staff expectations of students
- Strong emphasis on basic skills
- Orderly atmosphere
- Monitoring student progress
- Inservice programs for faculty
- Informal exchange of ideas among faculty
- Time spent on basic skills

Purkey and Smith (1982) indicate several criticisms of all the research on school process variables. Longitudinal studies are rare. The samples of schools have been too narrowly confined to urban elementary schools. No widely published studies have examined schools with explicit improvement programs. Too little attention has been given to practical matters of creating schools with characteristics identified with effective schooling. Research methods tend to be weak and replication of procedures difficult. Nevertheless, Purkey and Smith conclude that the cumulative results of the studies they reviewed are persuasive.

The school process studies do appear to offer promising hypotheses. However, several important criticisms of the work render them less than conclusive. First, measurement of the key variables is difficult; therefore, replication of the findings is difficult. (See, however, Gross and Herriot [1965] for a useful example of quantitative evidence bearing on the leadership function.) Second, samples tend to be small and unrepresentative. Third, multivariate statistical analyses have not been feasible. Fourth, the between-school variance attributed to all sources of variation due to school characteristics typically is rather small (Hauser, Sewell, and Alwin 1975).* Consequently, no characteristics of schools are likely to account for a substantial portion of the variation in student outcomes. Finally, it is unclear whether school characteristics associated with effective schools have produced high student achievement. For example, it is possible, even likely, that high student achievements influence faculty expectations of students. The issue of causal ordering of variables has not been addressed in this literature. This conclusion applies to a number of school variables such as leadership quality and emphasis on basic skills.

Models of Learning

Selection of a structural model may have important bearing on the substantive conclusions of a study. Standard practice in past quantitative studies of school effects has been to use ad hoc linear regressions. While some of these are nested in a rough theoretical context (e.g., Rosenbaum 1980), linear models generally are stated and tested with cross-sectional data. Explicit connection between the empirical work and the learning process as it occurs over time generally is missing. Furthermore, the linear functional form does not express some excellent substantive hypotheses about the need for both exposure *and* readiness to produce learning, and the likelihood of declining marginal increments to learning with increased exposure and effort.

The ad hoc structural models generally used to guide statistical work on school effects using available data have yielded few even rudimentary accounts of learning as a process of change over time in the quantitative literature (see, however, Sorensen and Hallinan 1977). Since learning is defined by change over time, this is a serious conceptual shortcoming of most quantitative work.

A key conceptual element in an adequate model of learning is that learning must be defined by change. For example, the amount of vocabulary learned in a given time interval might be the number of words for which one knows the definition at the end of the interval, minus the number known at the beginning of the interval. Learning occurs over continuous time, however, so that defining it as a *rate* of change over a very short interval is indicated. A simplified linear model in which learning rate is the dependent variable is given by the following example:

$$\frac{dy}{dt} + a + by + cz,$$

where

$\frac{dy}{dt}$ = learning rate, i.e., derivative of knowledge (y) with respect to time,

---

*Between-school variance for a number of school outcomes ranges down from a high of about 20 percent. See table 4 in this report.

y = current level of knowledge or skill,

z = amount of exposure to new material (in a short interval), and

a,b,c = constant coefficients.

In this example, b is expected to be negative. Here it could be interpreted as indexing the rate of forgetting given no new exposure (i.e., z=0). The coefficient c is positive and indicates the rate at which new knowledge is assimilated.

Since learning generally occurs simultaneously in several domains, it is sensible to consider a simultaneous model in which several aspects of learning are combined. For example, learning mathematics, reading, academic self-concept, attitudes toward work, educational self-evaluations, and educational and occupational aspirations may all affect each other and be affected by the same set of status background, ability, and school characteristics variables. In this case it may be useful to apply a fairly standard simultaneous differential equation system (see Arminger 1983; Coleman 1968; Doreian and Hummon 1976; Hotchkiss 1979).* Limited use of a simultaneous model is given in chapter 5 of this report.

The goal of most cross-sectional studies of school effects is to estimate a reduced form, giving the total effects of background and school characteristics on learning rate. One of the primary conclusions implied by a dynamic model of learning is that such cross-sectional estimates depend on the assumption that equilibrium existed at the time the data were collected (i.e., that all learning had stopped) or on other assumptions that cannot be tested with available data. In chapter 4 of this report an interpretation of a cross-sectional model that does not depend on the equilibrium assumption is given. In the alternative interpretation the cross-sectional estimates index effects of associated independent variables accumulated over the lifetime of respondents. This interpretation is more satisfying than simply to say the cross-sectional coefficients are meaningless because they depend on the obviously untrue assumption of equilibrium. Of course, interpreting cross-sectional coefficients as accumulated effects also depends on untenable assumptions, but in developing the interpretation, these assumptions become explicit and may therefore serve as guides to future research.

A linear differential equation model such as given in the above illustration ignores an important aspect of learning, namely that learning generally is viewed as a consequence of interaction between exposure and student ability or learning readiness (McPartland and Karweit 1979; Sorensen and Hallinan 1977). The fundamental ideas in the interaction hypothesis are that (1) no one can learn material to which she or he is not exposed and (2) learning readiness is defined as the capacity to learn material to which one is

---

*This approach rests on the incremental learning theory recently associated with psychometric approaches to learning by Nucci and Walberg (1981). According to Nucci and Walberg, recent evidence suggests a need to reexamine theory of learning readiness stages associated with, for example, Piaget.

exposed. Readiness, therefore, depends on innate ability, effort, and possession of knowledge or skills needed to learn the new material (e.g., a grasp of algebra is necessary to learn calculus). With these basic ideas, then, learning new material requires both exposure and readiness; readiness cannot compensate for lack of exposure, and exposure cannot compensate for lack of readiness.

In this report, preliminary analyses of effects of dropping out of school are carried out using an interaction hypothesis similar to that proposed by Sorensen and Hallinan. Because of the added complexity of the interaction hypothesis, however, most of the empirical work in this report is carried out using linear models.

Walberg (1981) gives a thoughtful critique of the linear functional form used in most input output studies of school effects. As a substitute for the usual linear form, Walberg proposes an "educational production function" of the same functional form as the Cobb-Douglas as defined in economic studies of physical production. The general form of the Cobb-Douglas for educational outcomes such as achievement is--

$$Ach = a x_1^{b_1} x_2^{b_2} \cdots x_k^{b_k} u$$

$$\Sigma b_k = 1 \quad 0 \leq b_k \leq 1 \text{ , all } k,$$

where

Ach = achievement,

x_k = predictors of achievement such as ability, motivation, exposure to material, and so forth

u = random disturbance,

a, b_k = empirical constants.

Taking logarithms on both sides of the Cobb-Douglas produces an equation that is linear in the log of all variables and in the paramaters; hence, the log form of the equation can be estimated routinely. Walberg (1981) cites important advantages of the Cobb-Douglas form over the linear form, the most important of which are the following:

- Increase of any one x value while holding the rest constant produces diminishing marginal returns.
- If any x factor is zero (for example exposure), no learning occurs.
- Increasing all x variables proportionately increases achievement by the same proportion.
- The effect of any one predictor on achievement depends marginally on the values of the other predictors. (The Cobb-Douglas expresses the interaction hypothesis formulated by Sorensen and Hallinan.)

• The b_k coefficients are readily interpreted in terms of percentage increment in achievement for a given percentage increment in any x.

These points express important substantive claims about the nature of the learning process and therefore illustrate the importance of paying attention to the qualitative aspects of the functional form selected to express hypotheses about learning.

There are, however, two important shortcomings in Walberg's discussion. First, the Cobb-Douglas does not express the dynamics of learning. Second, many of the variables in educational research have no natural origin.* The Cobb-Douglas form depends critically, as we shall see, on the origin point of all variables in the equation.

The static nature of Walberg's formulation may be remedied in a number of ways, the simplest being to postulate the Cobb-Douglas as an equilibrium equation and then posit incremental shifts toward equilibrium, as follows:

$$y^* = a x_1^{b_1} \cdots x_k^{b_k} u,$$

$$\frac{dy}{dt} = \alpha(y - y^*),$$

where

y^* = equilibruim level of achievement,

$\frac{dy}{dt}$ = instantaneous rate of change in y with respect to time (t)--the derivative of achievement with respect to time,

α = empirical constant.

These equations generate a functional form that could, in principle, be estimated with longitudinal data of the sort available in the HSB, but the estimating equations are nonlinear in their parameters. Hence, estimation is not routine.

The lack of natural zero points in many variables used in educational research also could be remedied empirically by resorting to nonlinear estimation methods. The following general strategy could be pursued: Estimate--

$$\ln(y+h_1) = \ln a + b_1 \ln(x_1+h_2) + \cdots + b_k \ln(x_k+h_k)$$

*The practice of using proxy variables when analyzing large data sets poses a particularly complex problem in this regard since (1) the proxy may have no natural zero even though the concept that it purportedly reflects does, and/or (2) the zero point of the proxy and the concept may not coincide. An example of the first instance is the Duncan SEI measure of parents' occupational level used as a proxy for home environment. An example of the second case is the use of test scores to reflect achievement. Scoring a zero on a difficult test does not necessarily mean that nothing has been achieved.

where ln is the natural logarithm, and the b_j and h_j are constants.*
There are two shortcomings of this strategy. First, nonlinear estimation is expensive and time consuming. Secondly, the number of degrees of freedom due to the regression is nearly doubled by estimation of the h_j's.

For practical reasons, Walberg's formulation is not used in the remainder of this report. However, he reviews important issues regarding a theory of the process of education and learning. Key questions implied by the lack of well-defined origins for many variables used in study of "educational production functions" include: What are the critical variables that affect learning and how are they related to the (proxy) variables commonly used in quantitative analyses of large surveys? For example, if one's theory indicates that quantity and quality of home environment are crucial (as Walberg claims), but one has available only measures of parental social class, how should the information on social class be used in the analyses?

---

*It should be noted that least squares applied to this form will not, in general, yield the same parameter estimates as least squares applied to the antilog form (Walling, Hotchkiss, and Curry, 1984).

CHAPTER 3

DATA AND METHODS

HSB Sample

The High School and Beyond (HSB) survey was sponsored by the National Center for Education Statistics, and the data collection was carried out by National Opinion Research Center (NORC). The HSB is a major longitudinal survey of high school youth. Base year data were collected in 1980, the first follow-up was completed in 1982, and the second follow-up is in progress. Plans call for additional follow-ups at 2-year intervals. The base year survey contains data describing over 58,000 student respondents, split between students who were sophomores (N = 30,030) in 1980 and those who were seniors (N = 28,240).

Students in the sample completed questionnaires at each wave of data collection. The base year questionnaires requested information about respondents' background, personal characteristics, school experiences, career aspirations, attitudes toward work, part-time work during high school, and a number of other topics. The first follow-up for the younger cohort repeated most of the questions in the base year questionnaire, thus permitting intensive analysis of change. The first and second follow-ups of the older cohort and second follow-up of the younger cohort requested detailed information regarding work, family formation, education, military service, and attitudes.* In addition to the student questionnaire data, a lengthy questionnaire was completed by the principal or other administrator of each school during the first two waves of data collection, students completed cognitive tests, teachers completed a brief checklist in the base year only, and a subsample of parents completed base year questionnaires.

The present report makes use of the base year and first follow-up questionnaire data on the younger cohort, base year and first follow-up test data, and the base year principal data. The test data contain tests of verbal skills, mathematics, science, and civics. The principal data contain descriptions of schools in the sample, including variables such as number of students, race and gender composition of students and teachers, facilities, expenditures, labor relations between staff and school adminstration, school desegregation, use of competency testing, participation in various Federal and State programs, and principals' assessment of various school problems (e.g., drugs, deportment, attitudes of teachers).

The HSB sample was drawn using a multistage stratified and clustered design. The sampling units are schools. A master list of U.S. high schools was compiled by NORC using several sources. The master list contained 24,725

*See Frankel et al. (1981) and Jones et al. (1983) for details on the sample, data collection, and content of data. Coleman, Hoffer, and Kilgore (1982) also give a thorough review of the HSB data.

schools of which 1,122 did not fit the definition of the sampling frame;* the final realized sample of schools is somewhat different from the original sample. Nine sampling strata were used; table 1 summarizes the disposition of the sample for the base year.

The "regular public" and "regular Catholic" strata were sampled in proportion to the number of students attending. Schools in the other strata were oversampled as part of the stratified design. The design weight supplied as part of the data set compensates for the disproportionate sample design. It should be noted that the school response rate differs among strata, with lower

TABLE 1

DISPOSITION OF THE SCHOOL SAMPLE, BASE YEAR

School Stratum	Original Sample	From Original Sample and Substitutions for "Out of Scope Schools"	Substitutions for Refusals	Total Realized Sample	Column 2 as Percentage of Column 4
Regular public	808	585	150	735	79.6%
Regular Catholic	48	40	5	45	88.9
Alternative public	50	41	4	45	91.1
Cuban public	20	11	--	11	100.0
Other Hispanic public	106	72	30	102	70.6
Black Catholic	30	23	7	30	76.7
Cuban Catholic	10	7	2	9	77.8
High performance private	12	9	2	11	81.8
Other private (non-Catholic)	38	23	4	27	85.2
Total	1122	811	204	1015	79.9%

Source. Adapted from table 3.1-2 in Jones, et al. (1982, p. 15).

*Area vocational schools with no independent enrollment, for example, were excluded from the sampling frame. But in some cases the identity of these schools was not learned until after the original sample was drawn.

rates generally for public than for private schools.* The design weight is defined to help compensate for differences in response rates among strata.

Within each school in the final sample, 36 sophomores and 36 seniors in 1980 were selected as student participants. No substitutes for student nonrespondents were used. Overall, 82 percent of those students participated. Twelve percent were nonrespondents due to absence from school on both the original survey date and the makeup date. About 8 percent of sophomores and 11 percent of seniors who completed questionnaires did not take the cognitive tests.

Initially, all schools that participated in the base year survey were included in the sampling frame for the first follow-up. Some of those schools had closed by 1982, had no sophomores in 1980, or had merged with other schools in the sample; these schools were necessarily excluded from the sampling frame for the first follow-up. Forty schools were excluded for reasons such as these. Seventeen schools were contacted to solicit cooperation during the first follow-up because they had received pools of students from schools in the base year survey that had closed. While student questionnaires were administered in these 17 schools, the schools themselves were not added to the sample of schools.

The target sample of the younger cohort included all students who remained in the same school they had attended in 1980; the remaining members of the younger cohort were subsampled. Those remaining in their 1980 high school were surveyed and retested in groups in their school building. Others were resurveyed and retested individually or in small groups at designated locations. Sophomores who had not participated in the base year survey also were included in the first follow-up. In the older cohort, about 40 percent of the base year students were selected for inclusion in the first follow-up. Participants were resurveyed by a mail questionnaire, with telephone and personal interviews used to obtain information from nonrespondents (25 percent) to the mail survey. This report does not contain analyses of the older cohort data.

The same tests administered to the 1980 sophomores were administered again in 1982 to those in the 1980 sophomore sample, but the older cohort was not retested. The first follow-up questionnaires for the younger cohort were similar to the base year questionnaires. Questionnaires for the older cohort and school leavers among the younger cohort were substantially changed, however. The focus of these questionnaires is on work experience, educational experience, and family formation and parenthood.

---

*Only about half of the "other private schools" drawn in the original sample are contained in the realized sample. This fact is masked by the percentage in the last column of table 1, since the base of that percentage contains some substitute schools.

Merged File

A large working data file was created for the statistical analyses. This data file consisted of four components: (1) selected variables from the base year younger cohort data, (2) selected variables from the first follow-up younger cohort data, (3) selected variables from the base year principals' questionnaire, and (4) selected variables calculated as within-school means of the base year student data. The school means were calculated from combined younger and older cohort data, when both were available. Separate data files were created containing the selected variables in each of these four components. Each of these files contains data transformations needed for analysis. These four files were merged in such a manner that all cases in which the respondent did not participate in both the base year and first follow-up surveys were excluded. The resulting sample size is 27,118--just over 90 percent of the 30,030 members of the base year younger cohort sample.

Variables

Since the focus of this report is an investigation of the effects of high schools on characteristics of their students that influence employability after leaving school, there are two main classes of variables that are of interest: immediate outcomes of schooling that affect employability after leaving school and variables describing high schools and the experiences to which students are exposed while attending high school. Additionally, a large number of exogenous control variables are included in the analyses. The remainder of this section develops a rationale for the selection of outcome variables and describes the operational definitions of all variables used in the analyses. Reasons for including variables on the right side of equations predicting the outcomes are given in later chapters describing the findings.

Choice of Outcome Variables

Since investigation of personal characteristics that influence employment outcomes remains in flux, there exists no sharply defined list of schooling outcomes that should be included. Input-output studies of school effects generally have emphasized outcomes defined by cognitive tests (Coleman, Hoffer, and Kilgore 1982; Coleman et al. 1966; Mayeske et al. 1973; Murnane 1975; Summers and Wolfe 1977). A number of papers have emphasized the need to broaden the scope of investigation to include outcomes other than cognitive tests, however (e.g., Jencks and Brown 1977; Murnane 1975). Murnane (1975), for example, gives a brief list of goals that schools are expected to achieve; his list includes teaching basic skills and other academic subjects, skills needed to become a productive worker, creativity, self-discipline, self-confidence, and good citizenship. The topic of the present investigation helps to narrow the list somewhat, but the set of schooling outcomes remains diffuse.

Outcome variables to be used in the present report may be classified into five broad categories. These five categories and the specific variables contained in each are as follows:

- Cognitive skills

  --Verbal test score
  --Mathematics test score
  --Science test score
  --Civics test score

- Career expectations

  --Educational expectation (approximate number of years)
  --Occupational expectation (Duncan SEI)

- Attitudes about self

  --Self esteem
  --Locus on control (internal, external)

- Work attitudes

  --Work orientation--scale measuring importance of work to the individual

- Behavior in school

  -- Index of deportment--including tardiness to school, absence when not sick, cutting class, misbehavior in the classroom, expulsion from school, and being in trouble with the law

Justification for considering cognitive skills to be part of preparation for employment is well grounded in the empirical and theoretical literature. Sociological studies of status attainment persistently find important indirect effects and small direct effects of test scores on occupational level and earnings (Alexander, Eckland, and Griffin 1975; Duncan, Featherman, and Duncan 1972; Hauser, Tsai, and Sewell 1983; Jencks, Crause, and Mueser 1983; Jencks et al. 1979, 1972; Sewell, Haller, and Ohlandorf 1970; Sewell and Hauser 1975). In so far as test scores indicate accumulated knowledge rather than "innate" ability, human capital theory would lead one to expect a positive effect of test scores on wages. The main line of argument in this respect is that test scores are indicators of past investment in human capital.* The sociologists Duncan, Featherman, and Duncan (1972) argue that cognitive tests may be interpreted as a cultural phenomenon. The values of the test constructors are reflected in the test items, and those values are permeated with beliefs about mental characteristics that are valuable in performing job tasks in an industrial economic system.

There is little doubt that career expectations of high school youth affect post-high school education and employment outcomes. Such relationships have been documented repeatedly in the status attainment literature (Duncan, Featherman, and Duncan 1972; Hauser, Tsai, and Sewell 1983; Jencks, Crouse, and Muesser 1983; Raelin 1980). While a priori hypotheses about the effects

---

*Human capital theorists, however, do not emphasize the relation between test scores and wage. Rather, they focus on the relations between wage and investments in human capital (see Becker 1 5).

of schooling on test scores are clear--schooling should increase test scores and good schools do so more rapidly than poor schools--a priori expectations regarding the influence of schools on career expectations are not entirely clear. A more complete discussion of the possibilities will be given later.

The rationale for including attitudes about self as outcomes of schooling is not as firmly grounded in the literature as is the case for test scores and career expectations. Kang and Bishop (1984) do report a positive effect of locus of control on wage and earnings. On a priori grounds it seems a good hypothesis that high self-esteem and belief that one has control over one's fate are associated with high educational achievement, high occupational level, and high earnings. These traits could be expected to increase the effort devoted to job search, lead one to be aggressive in demanding a good wage, and improve job performance.

Employers frequently emphasize the need for employees who are responsible and are willing to work hard (see, e.g., Hollerbeck and Smith 1984). These factors are reflected in the work attitudes and school behavior variables. The work orientation scale directly measures respondents' attitudes toward the importance of work. The index of school deportment reflects behaviors in school that are likely to have direct carryover into the workplace.

Two measures of each outcome variable are used in the analyses--one taken in 1980 and one in 1982.

Schooling Variables

A large number of variables describing schools and schooling experiences are used in the analyses reported here. These may be divided into two major classes and a number of subclasses. The two major classes are (1) variables describing characteristics of the entire school a respondent attended and (2) variables describing experiences in school to which specific respondents were exposed. A summary of the types of variables included is given below.

School characteristics. Most of the variables describing schooling refer to characteristics of schools. Given the vigorous debate during the last 2-3 years regarding the relative quality of public and private schools, it is important to include "sector" variables in the equations. While the main purpose here is not to compare private to public schools, three binary variables describing school sector are included: one for the regular public schools, one for regular Catholic schools, and one for "other" private schools. Originally, a dummy variable for "elite" private schools was included, but the sample design weight applied to this category of schools is so small that effect estimates were not significant. The variable was therefore dropped from the analyses. Two variables describing school desegregation are included: whether the school was under court order to desegregate, and percentage of students bussed to achieve racial balance. A number of school demographic variables are included, such as number of students, percentage black, and average family income of students. Four variables indicative of student academic context are included: percentage of the senior class of 1979 that attended college, dropout rate, proportion of 10th graders in 1980 who were in the vocational track, and percentage who were in the general track. Three variables concerning labor relations between teachers and the administration are included: percentage of the staff that holds membership in the American Federation of Teachers, percentage in the National Education Association, and whether there had been a teachers' strike in the 4 years prior to the survey. Several variables describing resources (human and physical) also are included, such as expenditures per pupil, whether the last school tax levi passed, vocational and academic facilities, teacher-to-student ratio, ratio of teacher aids per teacher, percentage of teachers with an advanced degree, beginning teacher salary, percentage of teachers with 10 or more years tenure at the school, and average teacher absenteeism. Three indexes rating conditions in the school are included. Two of these are averages within schools of student responses; the other is derived from responses to the base year principal questionnaire. These indexes contain items describing building quality, school spirit, disciplinary environment, teacher interest in students, and teacher clarity. Five variables describing the school curriculum are included. These are number of math and science courses offered, number of vocational courses offered, number of other courses such as sex education and family life that have sometimes been referred to derisively as "frills," participation in Upward Bound, and participation in work study programs. Two features having to do with pedagogical methods form part of the data. These are ability grouping in 10th grade English and requirement of a minimum competency exam to graduate. Two variables describe the aggregate exposure of students in a school to education. One is the average daily attendance percentage, and the other is the number of class hours per year. Finally, the index of student deportment is averaged for each school to give indication of the disciplinary environment of the school.

Individual exposure to schooling. A total of 12 variables describing individual student's school experiences are used in the analyses. Nine of these indicate the number of hours of credit taken in various academic and vocational subjects. One is a dummy variable indicating academic curriculum track. The last one is a dummy variable for dropping out of school.

Exogenous Control Variables

A standard set of background variables is used in most of the regressions. These exogenous variables include eight region dummy variables, gender, race, ethnicity, presence of both parents in the home, parental education and occupation variables, number of siblings, home ownership, number of rooms in the home, family income (log), and a count of family possessions (e.g., two or more cars or trucks, a microcomputer, video tape player (recorder).

Statistical Analyses

Exploratory statistical analyses are conducted to identify effects of school characteristics and processes on the outcome variables. Ordinary least squares regression is applied by entering correlation matrices to the regression procedure. Each correlation in these correlation matrices was calculated with every case in which both members of the pair of variables were present (see Hurtel [1976] for a discussion of alternative methods to handle missing data). One of the chief features of these regressions is that the time two measure of the outcome variable is defined as the dependent variable, and the time one measure is included in the set of regressors. This strategy is derived from a linear differential equation model of the process of learning as described briefly in the preceding chapter and more fully in later chapters. The regressions are, in this way, connected to an explicit model of the dynamics of learning. Inclusion of the lagged dependent variables also constitutes an important step in answering criticisms leveled at cross-sectional input-output studies. Such criticism claims that observed differences among schools are in part or totally due to differences among students at intake rather than to differences produced by schooling and that controls for socioeconomic background and personal characteristics do not adequately adjust for between-school differences at intake. Studies such as the Coleman, Hoffer, and Kilgore (1982) report on public-private school differences are particularly vulnerable to this type of criticism. (See Alexander and Pallas 1983; Goldberger and Cain 1982).

It is useful to elaborate on two aspects of the interpretation of the regressions. First, each regression is algebraically equivalent to a regression in which a change score is the dependent variable and the time one component of the change is included as a regressor. This fact is easily derived. Let the regression in which the time two measure is the dependent variable be represented as follows:

(1) $y_2 = a'x + by_1 + u,$

where

y_2 = time two value of the dependent variable,

y_1 = time one value of the dependent variable,

x = a column vector of exogenous variables, $x_1 \equiv 1.0$,

u = a random disturbance,

a = a column vector of coefficients comformable with x (a' = transpose of a),

b = coefficient on the lagged dependent variable.

Subtracting y_1 from both sides establishes an equation in which the change score is the dependent variable and y_1 is one of the regressors:

(2) $y_2 - y_1 = \quad y = a'x + (b-1)y_1 + u.$

Note that the coefficients on x are unaffected by this operation. The coefficient on y_1 is affected but in an entirely interpretable and explicit way. If $0<b<1$, then the coefficient in the change equation will be negative; this is to be expected and explains the regression to the mean phenomenon in a substantive way. Statistical estimates of parameters will be consistent with the relations derived here from the structural equations.*

The second aspect of interpreting the regressions that bears some discussion is related to the length of time between measurements. Obviously, if the time period were 1 year long instead of 2, one would expect the regressions to vary in a systematic way. The differential-equation model informs us about the manner in which the regression coefficients depend on the length of time between measurements. For simplicity, take a single-equation model such as the following:

$$\frac{dy}{dt} = a'x + by.$$

The integral form is a regression equation like--

$$y_2 = \alpha'x + \beta y_1.$$

In this simole model, the following relationship between the coefficients of the differential equation and those of the regression equation hold:

$$\alpha_j = \frac{a_j}{b}(e^{bt}-1),$$

$$\beta = e^{bt}.$$

Assuming b is negative, the absolute value of the α_j increases as the length of time between measurements increases, but β declines. As t goes to infinity an equilibrim is established-- $y_\infty = \sum_j \frac{a_j}{b} x_j$

(see Coleman 1968; Doreian and Hummon 1976; Hotchkiss 1979; Nielsen and Rosenfeld 1981). Clearly, the regression coefficients are not the fundamental paramaters of the process under studv here. It would appear that the parameters a_j and b in the differential equation are fundamental, since they are not time dependent. Nielson and Rosenfeld argue that their ratios, a_j/b are fundamental since they determine equilibrium values of y. Nevertheless, the regression coefficients do contain important information about the process; they summarize the accumulated effects of the x variables on y over, in the present case, a 2-year period. This is important information in a policy

---

* It should be noted, however, that R-square for the change equation does not in general equal the R-square for the equation in which y_2 is the dependent variable. Also, standardized coefficients are affected by the switch from equation (1) to equation (2). However, it is not sensible to calculate the usual standardized coefficients for equation (2), because those are affected by the standard deviation of y. The best strategy for calculating standardized coefficients is to standardize both time one <u>and</u> time two variables with the time one means and standard deviations, so that changes in central tendency and variation are not removed from the data. Standard calculating algorithims for this procedure are not contained in statistical packages, however.

context. One certainly might want to know the expected change in, say, math test scores over a 2-year interval as a result of a policy decision to increase student exposure to mathematics classes. Of course, the policymaker may also want to know the expected effects over a 1-year and a 3-year interval. Here the importance of the fundamental parameters of the differential equation enter in--those coefficients can be used to produce the desired estimates of effects over any arbitrary time interval.

One of the chief advantages of access to longitudinal data is that estimates of accumulated effects over the time period between measurements can be calculated, and these estimates control for input differences among respondents. As with any investigation, however, there remain threats to unbiased estimates of the structural coefficients. In particular, if a factor that is constant over time but correlated in cross-section with y is omitted from the set of regressors, OLS regression including lagged y on the right will produce biased estimates (Hannan and Young 1977). With three waves of data, statistical methods such as generalized least squares may be used to help correct the bias, but with two waves of data, OLS appears to be the only practical alternative. Boardman and Murnane (1979) develop a very general model of school achievement from which they conclude that OLS estimates using two waves of data, as carried out in this report, produce biased estimates of the effects of schooling unless fairly strict assumptions are imposed. Specifically, they show that the partial correlations between schooling characteristics in the current period and schooling characteristics in all previous periods must be zero when controls for lag-one school achievement and student characteristics are included. The assumption imposed by the differential equation is presumably equivalent to those cited by Boardman and Murnane, but they are more informative because they are stated in terms of the substantive process.

In evaluating the importance of statistical assumptions, it must be recalled that estimates of effects necessarily proceed under simplifying assumptions. All models are underidentified until assumptions are imposed. It is incumbent on the researcher, therefore, to state the assumptions clearly in terms of the substantive process under study. Ultimately, it would seem, social science must take the next step beyond estimation of the effects under stated assumptions; it must use those estimates to produce forecasts. Only with accurate forecasts derived from a theoretical model can convincing tests of those models be generated.*

For the present study and research on school effects more generally, the debate over appropriate measures of effect reviewed in the previous chapter leaves an important unresolved issue--what statistic(s) should be used? Increments to R-square do not measure response of an outcome to changes in an

---

*While some statistical methods such as LISREL do produce tests of assumptions imposed on a model, those tests can be used only when a given model carries more assumptions than are needed to identify it (overidentified model). The tests are of the overidentifying assumptions. If the test rejects the null, those overidentifying assumptions can be relaxed. If necessary, all overidentifying assumptions can be dropped. There are always assumptions remaining that cannot be tested with the data available.

input. Both R-square and standardized regression coefficients are sensitive to differences in variances among variables in a regression model. These differences may be due to historical accident or to deliberate policy. It seems particularly ironic to conclude that a variable is important (unimportant) as a policy instrument if the conclusion rests on past policies that influenced the statistic used to assess the viability of future policy alternatives. Wiley (1976) strongly advocates using unstandardized regression coefficients. Given well-established metrics for all variables, unstandardized regression coefficients do give the most easily interpretable estimate of the changes to be expected from a unit change in a specified independent variable; with arbitrary metrics such as test scores and attitudes, however, unstandardized coefficients are quite difficult to interpret. Moreover, they do not provide an adequate basis for comparing the magnitude of effects between two variables with different natural scales. Further, their values can be changed arbitrarily by a linear change of scale. When analyses contain numerous variables without firmly established scales, as in educational research, the difficulty of comparing unstandardized regression coefficients among studies becomes acute. Cain and Watts (1970) propose to convert all input variables to dollar units as a means for rendering effect coefficients comparable. Such conversion is not routine, however, and therefore cannot be easily used in exploratory studies. Since, in fact, practically all research in education production functions must be viewed as exploratory, the cost of converting all input variables to dollar units can seldom be justified (see Coleman 1970).

What, then, is one to conclude? None of the types of coefficients offer properties that recommend them unambiguously. It therefore seems prudent to report more than one statistic where possible and to make selections based on particular contexts and on ease of computation. Since, for example, it is easier to calculate partial correlations (or their square) than standardized regression coefficients when examining overall school effects, and since partial correlations and partial standardized regressions generally are of comparable magnitude, the partial correlations are sometimes presented in this report. One important advantage of partial correlations over standardized regression coefficients is that the former can be used to summarize effects of a large number of dummy variables more readily than the latter. First, the partial correlations are easier to calculate. Second, standard formulas for correcting them for loss of degrees of freedom are available, whereas such formulas are not available for standardized regression coefficients.

In chapter 4 the total effects of differences between schools are assessed by conceptually introducing a dummy variable for all but one of the 1,015 schools in the sample The object of this exercise is to discover to what extent differences between schools that are not captured by a vector of school characteristics constructed from the HSB data nevertheless produce differential changes in the outcome variables.

With over 1,000 categories in the school variable, however, it is not practical to use dummy variable regression with standard computing algorithms. Instead, the analyses reported here were carried out by comparing regressions in which raw data are input to regressions with the same set of regressors but for which all variables input to the regression calculations were deviated from their school means (see Judge et al. 1980, pp. 330-31). From a comparison between these two regressions, it is straightforward to calculate an F ratio testing the hypothesis of total school effects (using the explicit regressors in the calculations as controls) to find the increment in R-square due to between school differences and to calculate a squared partial correlation showing the proportion of residual variance accounted for by differences between schools (see Namboodiri, Carter, and Blalock 1975). The partial correlation is equivalent to a partial correlation for an interval measure of school characteristics defined by assigning each school a numeric score equal to the dummy regression coefficient associated with the school. It also is possible to calculate a standardized partial regression coefficient reflecting total between school effects,* but calculating algorithms are not as straightforward; hence, the standardized regression coefficients are reported only in selected cases. Partial correlations are used in several instances to summarize combined effects of several variables.

Throughout the analyses, the 1 percent level of significance for a two-tailed test is used as the critical level determining whether a coefficient is statistically significant. This relatively low criterion is used to offset the inefficiency of the HSB sample due to departures from a simple simple random design. Lowering the level of significance as a way of compensating for the inefficiency of the HSB sample has been suggested by .

Summary and Conclusions

The Equal Educational Opportunities Report (EEOR) (Coleman et al. 1966) stimulated a dramatic increase in large-scale statistical studies of school characteristics that influence the learning rate of their students. These input-output studies generally have relied on survey data at a single point in time. Student test scores, student responses to questionnaires, and surveys of school administrators constitute the primary sources of data. The basic strategy has been to treat test scores of academic achievement as dependent variables (output), use administrator reports of school input, and use student reports of their socioeconomic status (SES) characteristics, race, and gender as control variables. Findings of this type of research generally have been interpreted to show that SES characteristics and personal characteristics (race, gender, and so on) of the students exercise much stronger influence on the cross-sectional differences among student test scores than do the school inputs.

A number of strong criticisms of this type of research render the conclusions less than compelling. First, the measures of school inputs are incomplete, imprecise, and neglect quality differences. Second, the cross-sectional nature of the data in most input-output studies renders them vulnerable to the charge that whatever differences among schools that are found

---

*The unstandardized coefficient based on assigning values of dummy regression coefficients to each school would be unity (1.0).

at a given time point are due to student differences at intake. Third, specific studies (such as the EEOR) have exhibited numerous idiosyncratic shortcomings. Examples include use of R-square increments to assess effects rather than regression weights, nonresponse bias, and atheoretical use of linear regression.

Two important responses to the input-output studies are (1) school process studies and (2) theoretically oriented work designed to structure equations that express our intuitive ideas about the process of learning more adequately than does the standard linear form. The school process studies have focused on aspects of schooling such as teacher expectations of their students, goals of schooling, administrator leadership, and disciplinary climate. These studies represent an obvious advance over exclusive use of school characteristics such as number of resources of specified types, per-pupil expenditures, and demographic composition of students. Yet most of them are based on small unrepresentative samples and rely on difficult-to-measure constructs.

Work on defining structural equations that improve the correspondence between statistical analyses and intuitive understanding of educational processes has made important contributions to the study of schooling. The primary shortcomings of this work are that theoretical expressions have not been subjected to very much empirical test, and many of the theoretical equations require nonroutine expensive statistical methodology.

It is clear that scientific understanding of effective educational policies and practices remains fairly primative, though important strides have been made in recent years. The present report is intended to contribute to accumulating knowledge of effective educational practices in several ways. First, use of longitudinal data in a large National data set combined with explicit models of processes over time permits substantial improvement in the quality of empirical tests of many old hypotheses. Second, application of an elementary change model of the way in which exposure and readiness combine to produce achievement demonstrates much stronger effects of schooling than has been found in previous work. Further, this model illustrates the potential payoff to expression of good intuitive hypotheses about learning processes in equation form and testing the resulting functions with empirical data. Third, use of longitudinal data helps to separate the effects of curriculum tracking (academic, vocational, general) from effects of selection into a track. Fourth, work with dynamic mathematical expression of educational and stratification processes permits reinterpretation of standard regression statistics--particularly comparisons between cross-sectional and longitudinal regressions.

CHAPTER 4

BETWEEN-SCHOOL EFFECTS ON STUDENT OUTCOMES: A REASSESSMENT

Recent research and theorizing regarding effective educational practices have focused on school processes, goals, and staff attitudes (Mackenzie 1983; Purkey and Smith 1982). While much of the research summarized in these reviews was carried out by making comparisons among schools, much of the content of the theorizing implies that variations of school processes that occur within schools ought to be the center of attention. Nevertheless, comparison of differences among schools remains an important item on the research agenda. Persistent claims that schools comprise a mini-social system suggest that between-school differences are important (Brookover et al. 1979; McDill and Rigsby 1973). Moreover, determination of the extent to which youth are advantaged or disadvantaged according to the school they attend remains an important equity issue and therefore a matter pertinent to public policy.

This chapter addresses two of the main criticisms of past research in the tradition of input-output studies of school effectiveness. First, it examines between-school differences in growth of cognitive skills. Since most studies of differences between schools have been based on cross-sectional data, they have been vulnerable to the charge that observed differences in achievement are due to average differences among students at intake. Controls for personal characteristics of students and their socioeconomic background, it has been alleged, are not sufficient to allay such fears (Alexander, McPartland, and Cook 1981). Second, this chapter investigates school effects on changes in outcomes other than cognitive skills. These outcomes are determined for their relevance to employment after leaving school. They include educational and occupational expectations, self-esteem, locus of control, work attitudes, and deportment in school. In past work, test scores indicating cognitive achievement have dominated as measures of school outputs. Despite repeated calls for broadening the spectrum of school outputs (Alexander, McPortland, and Cook 1981; Rutter et al. 1979; Smith 1972; Spady 1976), only a relatively few studies report on outputs other than cognitive tests (e.g., Hauser, Sewell, and Alwin 1976; Jencks and Brown 1975; Rutter et al. 1979).

The chapter is organized into two main sections plus a summary and conclusions. The first section develops a dynamic model of the effects of personal characteristics and socioeconomic background on the outcome variables. This discussion provides the framework for subsequent analyses of school effects. The second section examines the total school effects on changes in the outcome variables using a dummy regression methodology.

Socioeconomic Background and Personal Characteristics

The study of schooling is inextricably interwoven with the study of stratification processes. Since the landmark Blau-Duncan (1967) study reported that effects of socioeconomic background on achievement are largely mediated by education, the finding has been replicated in numerous data sets (Featherman and Hauser 1978; Hauser and Featherman 1977; Hauser, Tsai, and Sewell 1983;

Jencks, Crouse, and Meuse 1983). Further, explicit studies of school effects universally have included the obligatory controls for socioeconomic status background and for personal characteristics (race, gender,and so on). Inadequate control, especially with cross-sectional data, has frequently been grounds for criticism (e.g., Hauser 1971).

One of the most frequent criticisms leveled against the EEOR (Coleman et al. 1966) has been the absence of an explicit structural model (Bowles and Levin 1968; Cain and Watts 1970; Hanushek and Kain 1972). Hauser (1971) raises a similar point regarding the study of "contextual effects" of schools on cognitive achievement, grades, and career expectations. As a preliminary step in studying school effects, therefore, a basic model of the processes under study is presented. The model certainly cannot be viewed as a fully realistic representation of the complex empirical world, but it does conform in broad outline to extant specifications in the literature and extends most of those specifications by imposing an explicit theory of the dynamics of the learning process. The dynamic statement of the theory provides an integrative framework that helps to interpret apparently large discrepancies between cross-sectional and longitudinal estimates of coefficients in a theoretical model. The model may be generalized in a number of ways, but for this chapter a simple representation is maintained. Chapter : expands the basic model by considering a system of causal feedback loops, and Chapter 6 expands it by proposing and testing an interaction model.

Basic Change Model

Consider, as an illustrative case, the development of the level of educational expectation--number of years of education one expects to complete. Change in educational expectation undoubtedly does not exhibit key characteristics of a smooth function that, strictly speaking, are required of a differential equation; nevertheless, as a first approximation, one may stipulate a theory about the instantaneous rate of change in educational expectation with respect to time.

A partial adjustment model often has been used to represent stratification processes with differential equations (Doreian and Humman 1974; Hotchkiss and Chiteji 1981; Rosenfeld 1980). Let y represent educational expectation, and let y* denote an equilibrium level of y--a point at which y no longer changes. The partial adjustment model is written as follows:

$$(1) \quad \frac{dy}{dt} = b(y - y^*), \qquad b<0.$$

Thus, if y is greater than equilibrium, the change is negative and vice versa.

Setting y* to a function of one or more variables that one believes influence equilibrium level of educational expectation and substituting it into equation (1) lead to an elementary structural equation expressing the dynamics of the process of developing educational expectations. As a first approximation, this chapter follows precedent by setting y* to a linear function of personal characteristics and socioeconomic background:

(2) $y^* = p_0 + p_1x_1 + \ldots + p_Jx_J$,

where the x_j are exogenous variables--personal characteristics and socioeconomic background--and the p_j are constant (over time and individuals). By substituting (2) into (1), a linear differential equation of the following form is generated:

(3) $\frac{dy}{dt} = a_0 + a_1x_1 + \ldots + a_Jx_J + by$

with $a_j = -bp_j$. Since b is negative, the sign of a_j and p_j match.

In the simplest form of the model, the x_j are presumed constant over time (but not over individuals). This assumption is strictly true for personal characteristics such as race, gender, and ethnicity. Over short periods, it also tends to be true for parental socioeconomic characteristics such as father's or mother's education, and, to a lesser degree, parental occupational level and family income. Obviously, a fully realistic model would incorporate changes in some of the exogenous variables. It would also postulate interdependency among the various outputs of schooling under study here (cognitive achievement, educational expectation, occupational expectation, and so on, see chapter 5).

As it stands, equation (3) cannot be used in empirical work because observations on the instantaneous change rate (dy/dt) are never available. Equation (3) represents an elementary conception of the continuous time process by which individuals adjust their educational expectations to the contingencies of their personal circumstances. To provide a basis for empirical evaluation, equation (3) is solved to yield predictions about the behavior of longitudinal data in which measurements are spaced over relatively long time intervals. Integration of (3) yields the following functional form:

(4) $y_t = \alpha_0 + \alpha_1x_1 + \ldots + \alpha_Jx_J + \beta y_{t-\Delta t}$,

where Δt represents the length of the time interval between measurements, and the α_j and β are constant over individuals but <u>not</u> over Δt.* Upon adding a disturbance to (4), linear regression methods may be used to estimate the α_j and β. The fundamental parameters a_j and b may be estimated from the regression constants, as shown in chapter 3. While there is some question about bias in parameter estimates when applying OLS regression to (4), with just two waves of data, OLS appears to be the only practical method (see Hannan and Young 1977).

It is useful to note that (4) is equivalent to a discrete time change model; subtracting $y_{t-\Delta t}$ from both sides makes the equivalence explicit:

(4a) $\Delta y = \alpha_0 + \alpha_1x_1 + \ldots + \alpha_Jx_J + (\beta-1)y_{t-\Delta t}$

---

* See chapter 3 of this report for a more thorough discussion of these relationships.

The important feature of the differential equation, as contrasted to a difference equation, in this context, is that the differential equation produces an equation of the form of (4) for measurement intervals of any arbitrary length; whereas, a difference equation specifies a theory about change over a time interval of specified length and cannot handle observations that are not spaced at even multiples of that length.

The same basic model is applied to all 10 outcomes studied in this chapter. These outcomes are as follows:

1. Educational expectation--Each student was asked to indicate that level of education he or she expected to complete. Responses were converted to approximate number of years of schooling.

2. Occupational expectation--Respondents were asked to check one of 14 broad occupational categories. Responses were converted to approximate Duncan SEI scores.

3. Self-esteem--Respondents answered four questions about their sense of self worth. These were standardized and averaged by National Opinion Research Center (NORC). The resulting scale is used to define operationally self-esteem in the analyses reported here. High values on the scale indicate high self-esteem.

4. Locus of control--Respondents answered four questions about their sense of "agency" in determining events in their own lives. These items were aggregated into a single index by NORC using procedures identical to those used for self-esteem. High values on the index represent belief in internal rather than external control over one's fate.

5. Work values--Respondents answered three questions concerning the degree to which they valued paid employment. These three items were aggregated into a single index of work values using the same procedures as were applied to the previous two variables. High values on the index indicate that work is highly valued.

6. Deportment--This variable is an index of six items that indicate degree to which respondents' behavior conforms to normative patterns. The index includes days absent from school while not sick, days tardy to school, self-report of discipline problems in school, whether suspended from school, whether cuts classes, and whether in "trouble with the law." Because of the highly variable scales among these variables, each item was standardized prior to calculating the aggregate index value. High values of the index indicate nonconformity to norms.

7. Verbal test score--This variable is the average of vocabulary, reading, and writing tests administered as part of the HSB survey. Each input variable has a mean of 50 and nominal standard deviation of 10.

8. Mathematics test score--This variable is the mean of two mathematics tests administered as part of the HSB survey. Both input tests have nominal means of 50 and standard deviations of 10.

9. Science test score -This is a single test with nominal mean of 50 and standard deviation of 10.

10. Civics test score--This is a single test with nominal mean of 50 and standard deviation of 10.

The test scores are standardized versions of formula-scored tests (right-wrong) with means set to 50 and standard deviation set to 10.*

While exposition of the change model was given using educational expectation as the example, the basic idea generalizes without difficulty. The generalization is immediate and obvious with respect to occupational expectation. For the attitudinal variables and deportment, the change model rests on the assumption that experiences indicated by personal characteristics such as race and gender and by socioeconomic background determine ultimate values these outcomes. Changes over time reflect, in part, adjustments to such experiences. A similar line of reasoning applies to cognitive achievement. The background variables affect motivation, ability, and exposure that directly influence changes in achievement

Selection of a set of exogenous variables for inclusion in the model depends more on historical precedent and empirical observation than it does on a tightly woven theory. As reviewed in detail previously, the EEOR (Coleman et al. 1966) found that socioeconomic background had relatively strong effects on verbal test scores. Virtually every input-output study of schooling since has replicated this finding (Bridge, Judd, and Moock 1979). The major variables that have been included under the rubric of background variables include parental education and occupation, family income, number of siblings, presence of

---

* The standardization constants (means and standard deviations) were calculated by NORC, but we have been unable to obtain their exact values from NORC. Apparently the constants were calculated from somewhat different samples than those ultimately released, because our attempts to reproduce the exact values of the means and standard deviations have not been successful. This is the reason for using the term nominal in describing the scales. After computer runs for this paper were completed, it was learned that new standardization constants were used for first follow-up tests, thereby effectively removing changes in average and variance from the test scores. Removal of these changes is not desirable for present purposes, so adjustment of the data became necessary. To facilitate completion of this document, the regression runs were not repeated with revised first follow-up test scores. Instead, we approximated the standardization constants using the public use HSB files and adjusted the (unstandardized) regression coefficients with a hand calculator. Since our data runs do not yield exactly the expected mean and standard deviations on the standardized test scores, these procedures probably have introduced slight error in the coefficients. These errors should not be large enough to be of substantive importance, however.

parents in the home, race, gender, and ethnicity. While most studies include some of these variables, relatively few include them all. One advantage of the HSB is that it does include a full complement of background variables; all those just mentioned are included in the models reported here. Additionally, a possessions index, home ownership, and number of rooms in the home are included.

Cross-Sectional and Longitudinal Analyses

This subsection shows how the change model can be used to develop an integrated interpretation of regression coefficients calculated from cross-sectional data and regression coefficients calculated from longitudinal data. Generally, if longitudinal data are available, the consensus is that model estimation should make use of the longitudinal data and ignore any cross-sectional calculations, because the latter are thought to produce biased parameter estimates (Alexander, McPartland, and Cook 1981, for example, make this claim). On the other hand, the vast majority of quantitative studies of school effects have been conducted with cross-sectional data. Consequently, a theoretical framework that gives a useful interpretation of these results in terms of a change model has important consequences for evaluating past research. In his groundbreaking paper on study of change, Coleman (1968) notes that under the equilibrium assumption, cross-sectional regressions produce direct estimates of paramaters of a differential equation up to a constant of proportionality. This point has been repeated in the literature (e.g., Doreian and Hummon 1974; Hotchkiss 1979). It is argued here, however, that even in the absence of equilibrium, cross-sectional regressions may provide useful information.

To develop this interpretation, consider the concept of verbal achievement as measured by a standardized test. At birth everyone's level of verbal achievement is the same--he or she has no knowledge. Hence, if y_t represents verbal achievement at time t, then $y_0 = 0$.* Since the values of the constants in the integral equation (4) depend on the lag time (Δt), it is useful to rewrite (4) with this dependency explicitly included in the notation--

$$(4b) \quad y_t = \alpha_0(\Delta t) + \alpha_1(\Delta t)x_1 + \ldots + \alpha_J(\Delta t)x_j + \beta(\Delta t)y_{t-\Delta t} + u(\Delta t),$$

where $\alpha_j(\Delta t)$ and $\beta(\Delta t)$ indicate parameters to be applied when the length of time between measures is Δt. Setting $\Delta t = t$, and $y_{t-\Delta t} = y_0 = 0$, (4b) becomes--

$$(4c) \quad y_t = \alpha_0(t) + \alpha_1(t)x_1 + \ldots + \alpha_J(t)x_J + u(t).$$

* For a formula-scored test there is some ambiguity on this matter, but the assumption $y_0 = 0$ may be imposed as a first approximation.

This last form is a cross-sectional equation. Thus, under the stated assumptions, a cross sectional model estimates the total accumulated effects of the background factors on verbal achievement--from the beginning of the process (say birth) until the present at time t. The assumptions underlying this conclusion are important and bear repeating. In the present context, three assumptions are pivotal: (1) the x values remain constant over the life of the process; (2) the value of y at $t_0 = 0$ is constant across individuals--for simplicity it is set to zero; and (3) the fundamental parameters of the differential equation (a_j and b in eq. (3)) remain constant over individuals and over the entire life of the process.

Assumptions (1) and (3) are problematic. They almost certainly are violated to some degree. One of the values of the dynamic formulation is that they make the assumptions explicit; knowing the critical assumptions should serve as a guide to future research, since they are in principle testable.

Even with only two time points in the observations, preliminary tests are available. Since

$$\alpha_j(\Delta t) = \frac{a_j}{b}(e^{b\Delta t}-1),$$

a functional relationship between the longitudinal parameter estimates (eq. 4b) and the cross-sectional estimates (eq. 4c) is predicted. The ratio of the cross-sectional to the longitudinal estimates should be a constant across exogenous variables, namely--

$$(5) \quad \alpha_j(t)/\alpha_j(\Delta t) = (e^{bt}-1)/(e^{b\Delta t}-1)$$

If both Δt and t are known, and b is estimated from the longitudinal equation ($b = \ln \beta(\Delta t)/\Delta t$), the exact numeric value of the ratio is predicted.*

Empirical Tests

Information needed to conduct preliminary checks on these predictions is displayed in table 2. The table contains OLS estimates based on cross-sectional and longitudinal data from the HSB. First follow-up values of the dependent variables were used in the cross-sectional calculations. For each independent variable three rows are shown. Row one gives the cross-sectional regression coefficients, the second row gives the longitudinal coefficients, and the last row shows the ratio of the first to the second.

---

*Alternatively, one may wish to use (5) as a constraint on the estimation method, that is, calculate the cross-sectional and longitudinal parameters simultaneously subject to (5). The calculations would be nonlinear in the parameters and therefore would not be routine. Major advantages of such estimation strategy include relaxing the troubling OLS assumption that all regressors in (4b) are uncorrelated with the disturbance, more complete utilization of information in the sample, and a statistical test of the constraint relationships.

TABLE 2

CROSS-SECTIONAL AND LONGITUDINAL EFFECTS BACKGROUND AND PERSONAL CHARACTERISTICS ON TEN SPECIFIED OUTCOMES — DISAGGREGATED SES

		Dependent Variables									
		Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deport-ment Index	Self-esteem	Locus of Control	Work Value
Intercept											
	CROSS SEC	33.193***	33.261***	40.153***	30.494***	7.044***	3.075*	1.769***	-0.539***	-1.006***	0.030
	LONGIT	6.424***	5.455***	14.782***	22.890***	4.107***	3.355*	0.983***	-0.327***	-0.624***	0.059
	RATIO	5.167	6.097	2.716	1.682	1.874	1.141	1.799	1.650	1.741	0.510*
Lagged dependent variable											
	LONGIT	0.045***	0.009***	0.655***	0.446***	0.306***	0.277***	0.467***	0.300***	0.441***	0.295***
Gender (1=Female)											
	CROSS SEC	1.629***	-1.161***	-2.436***	1.281***	0.245***	9.364***	-1.365***	-0.049***	0.146***	-0.176***
	LONGIT	0.395***	-0.660***	-0.962***	0.722***	0.087**	5.889***	-0.917***	-0.006	0.090***	-0.131***
	RATIO	4.119	1.730	2.531	1.773	2.014	1.590	1.489	7.881	1.616	1.337
Race (1=Black)											
	CROSS SEC	-5.663***	-5.043***	-7.389***	-3.532***	0.73[illegible]***	2.117***	-0.180	0.222***	-0.055***	0.220***
	LONGIT	-1.018***	-1.089***	-2.599***	-2.218***	0.331***	0.701	-0.303**	0.119***	-0.023	0.164***
	RATIO	5.562	4.632	2.880	1.596	2.227	2.712	0.592*	1.864	2.385	1.342
Ethnicity (1=Hispanic)											
	CROSS SEC	-4.469***	-4.125***	-4.841***	-3.039***	0.117	0.650	0.384***	0.075***	-0.127***	0.065***
	LONGIT	-0.600***	-0.919***	-1.240***	-1.487***	-0.070	-0.010	0.061	0.050*	-0.071***	0.062***
	RATIO	7.445	4.480	3.078	2.044	-1.679*	-36.599*	6.321	1.501	1.706	1.052
Father not in household (1=Not in household)											
	CROSS SEC	-0.867***	-0.901***	-0.717***	-1.025***	-0.106*	0.141	0.787***	0.026	-0.032*	0.063***
	LONGIT	-0.298**	-0.199	-0.223	-0.888***	-0.054	0.075	0.439***	0.013	-0.028*	0.044**
	RATIO	2.911	4.529	3.210	1.154	1.958	1.868	1.794	2.000	1.121	1.429
Mother not in household (1=Not in household)											
	CROSS SEC	-2.642***	-2.209***	-2.431***	-2.341***	-0.368***	-1.136	0.540***	-0.045	-0.100***	-0.097***
	LONGIT	-0.959***	-0.695***	-1.049***	-1.381***	-0.233* *	-1.129	0.046	-0.022	-0.062***	-0.068**
	RATIO	2.753	3.177	2.310	1.695	1.577	1.007	11.683*	2.037	1.603	1.434
Father's occupation											
	CROSS SEC	0.022***	0.022***	0.005	0.014***	0.008***	0.070***	0.000	0.000	[illegible].001*	-0.000
	LONGIT	0.002	0.007**	-0.003	0.007	0.005***	0.031***	-0.000	0.000	0.[illegible]00	-0.000
	RATIO	14.290*	3.204	-1.749*	2.035	1.688	2.261	-0.618*	0.644*	1.703	1.101
Father's education											
	CROSS SEC	0.506***	0.676***	0.592***	0.490***	[illegible].216***	1.039***	-0.038*	0.012***	0.023***	-0.006
	LONGIT	0.147***	0.239***	0.298***	0.319***	0.108***	0.071***	-0.014	0.009***	0.014***	-0.005
	RATIO	3.974	2.828	1.989	1.550	1.996	1.192	2.754	1.331	1.669	1.188
Mother's occupation											
	CROSS SEC	0.020***	0.012***	0.014***	0.016***	0.004***	0.045***	0.002	-0.001	0.000	0.000
	LONGIT	0.006**	0.011***	0.005	0.012***	0.002**	0.027***	0.003	-0.000	-0.000	0.000
	RATIO	3.543	1.590	2.557	1.366	1.996	1.650	0.777*	1.174	-4.229*	1.565
Mother's education											
	CROSS SEC	0.344***	0.375***	0.285***	0.243***	0.121***	0.425***	0.011	0.009*	0.010***	-0.006
	LONGIT	0.084***	0.111***	0.104***	0.132***	0.042***	0.295**	0.019	0.003	0.006*	-0.004
	RATIO	4.097	3.392	2.747	1.845	2.879	1.439	0.557*	1.739	1.707	1.365

TABLE 2--Continued

	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deportment Index	Self-esteem	Locus of Control	Work Value
Number of siblings										
CROSS SEC	-0.407***	-0.275***	-0.337***	-0.323***	-0.081***	-0.258***	0.096***	-0.010***	-0.019***	-0.010***
LONGIT	-0.093***	-0.092***	-0.110***	-0.197***	-0.037***	-0.165*	0.035*	-0.005	-0.010**	-0.005
RATIO	4.383	2.991	3.064	1.637	2.213	1.563	2.703	2.293	1.934	2.301
Log of family income										
CROSS SEC	1.079***	1.278***	0.930***	0.856***	0.364***	2.212***	0.315***	0.079***	0.099***	0.079***
LONGIT	0.292***	0.467***	0.158	0.461***	0.158***	1.677***	0.232***	0.041***	0.055***	0.058***
RATIO	3.691	2.736	5.882	1.860	2.299	1.319	1.361	1.906	1.823	1.356
Possessions index										
CROSS SEC	2.062***	0.923*	1.550***	1.053*	0.816***	2.439*	-0.432*	0.175***	0.206***	0.218***
LONGIT	0.276	0.034	0.824*	0.358	0.404***	1.470	-0.241	0.075*	0.135***	0.135***
RATIO	7.473	27.165*	1.881	2.945	2.019	1.659	1.792	2.340	1.531	1.615
Home ownership (1=Yes)										
CROSS SEC	0.733***	0.719***	1.033***	0.363	0.034	0.799	-0.215*	0.005	0.000	-0.008
LONGIT	0.208*	0.136	0.366**	0.044	0.031	0.819	-0.005	0.004	-0.003	-0.012
RATIO	3.515	5.279	2.821	0.165*	1.088	0.975*	43.174*	1.442	-2.631*	0.000*
Number of rooms in home										
CROSS SEC	0.251***	0.261***	0.266***	0.244***	0.026*	0.042	-0.010	0.001	0.009***	0.000
LONGIT	0.064**	0.122***	0.074*	0.167***	0.010	0.041	-0.004	-0.001	0.005	-0.000
RATIO	3.918	2.965	3.615	1.461	2.494	1.032	2.709	-0.794*	1.867	-3.042*
AVE RATIO	4.468	3.546	3.002	1.761	2.000	1.572	2.534	2.248	1.731	1.424
SD RATIO	1.417	1.246	0.959	0.404	0.455	0.472	1.437	1.661	0.271	0.309
EST. BETA	0.808	0.724	0.670	0.433	0.521	0.379	0.630	0.597	0.423	0.298
EST. B	-0.106	-0.162	-0.194	-0.419	-0.326	-0.405	-0.231	-0.258	-0.430	-0.605
R-SQ, C SEC	0.282	0.237	0.253	0.129	0.222	0.105	0.037	0.024	0.008	0.034
R-SQ, LONGT	0.747	0.659	0.572	0.293	0.443	0.169	0.182	0.162	0.257	0.120

* p ≤ .01 on cross-sectional and longitudinal coefficients. Excluded from calculation of average and standard deviation of ratios on "ratio."

** p ≤ .001.

*** p ≤ .0001.

Table 2--Continued

NOTE: The notation on the rows of the table are defined as follows:

CROSS SEC = cross-sectional coefficients

LONGIT = longitudinal coefficients

RATIO = ratio of cross-sectional to longitudinal coefficients

AVE RATIO = average of the ratios within the corresponding column (excludes outliers marked by *)

SD RATIO = standard deviation of the ratios within the corresponding column (excludes outliers marked by *)

EST BETA = estimated regression coefficient for lagged dependent variable using average ratio (see text)

EST B = estimated constant in the corresponding differential equation using average ratio (see text)

R-SQ, C SEC = R-square for cross-sectional equation

R-SQ, LONGT = R-square for longitudinal equation

The ratios of the cross-sectional coefficients on the exogenous variables to those produced from the longitudinal data are closer to being constant than one has any right to expect, given the several simplifying assumptions that must be imposed in order to justify interpreting them as a realization of the simple change model expressed by equation (3). In each equation, there are one or two outliers (except the deportment equation, where there are several). Neglecting outliers where the ratio is less than one or greater than eight, table 2 displays the mean ratio of cross-sectional to longitudinal coefficients for each equation, and the standard deviation of the ratios in each equation (more complete rationale for omitting outliers follows). The table also displays new estimates of the coefficients on the lagged dependent variable using the assumptions that the ratio of cross-sectional to longitudinal coefficients is equal to the calculated average ratio and that average age of the sample is 17.5 ($t = 17.5$). These estimates offer heuristic value only, since they were not calculated simultaneously with the coefficients on the exogenous variables. They do suggest, however, that the degree of bias in the OLS estimates is not severe for the test scores, educational expectation, locus of control, and work values. Bias in the remaining equations may be somewhat more serious.

In all cases, the average ratio of cross-sectional to longitudinal coefficients is substantially higher than the standard deviation, in only two cases (deportment and self-esteem) falling below twice the standard deviation. The coefficients of variation thus generally are less than one-half. It should also be noted that in every case in which the ratio is an outlier, one or both of the coefficients defining the ratio is not significantly different from zero. Given the dynamic model, if one coefficient in a given pair is zero, they both are.* Since the ratio is undefined in this case, the outliers may represent nothing more than sampling error.

It is concluded therefore that interpreting the cross-sectional coefficients as approximate indicators of total effects of each exogenous variable, accumulated from birth until the last year of high school (or age 17 or 18), receives modest support in these results. Certainly the data are sufficiently consistent with the model to encourage attempts to improve on the dynamic specification.**

One interesting observation in the ratios is that those for race and ethnicity are substantially above the average in the equation for verbal achievement and the equation for mathematics achievement. This is not true

---

*If $\alpha_j(t) = \frac{a_j}{b}(e^{bt}-1) = 0$, then $a_j = 0$ (or $bt = 0$). Hence, if $\alpha_j(t) = 0$, then so does $\alpha_j(\Delta t) = 0$, $t \neq \Delta t$.

**The model also predicts that the ratio of cross-sectional to longitudinal coefficients will be greater if the dependent variables are wave one measures of the outcomes than if first follow-up outcomes are used. This prediction is supported in 8 out of 10 cases. One of the exceptions is deportment--a poorly behaved equation in other respects as well. But the other exception is verbal achievement.

for science and civics tests, however, nor for the other outcomes. This pattern suggests that blacks and Hispanics have accumulated more disadvantage in basic skills before reaching high school than they accumulate after beginning high school. Verbal skills and mathematics are emphasized throughout elementary and junior high school, but emphasis on science and civics tends to be stronger in high school.

There are a number of noteworthy features in table 2. In view of the current concern over school discipline, the erratic pattern of coefficients and low R-squares for the school deportment index is interesting. Youth's behavior in school does not appear to be much influenced by traditional socioeconomic background variables. Gender has the strongest effect on deportment--girls are more orderly than boys. Following gender, a missing father figure has the next strongest impact on school deportment. The direction is as one would anticipate; those without a father or male guardian in the household misbehave more often. Family income (in logs) has the next strongest effect. Surprisingly, that effect is positive. No other variable has much impact on school deportment. It is interesting, nonetheless, to note that the effect of race on deportment is in the direction of blacks being better behaved than whites; whereas, Hispanics tend to misbehave more than whites.

Socioeconomic background variables have positive effects on career expectations, locus of control, and test scores. Their effects on self-esteem and work values, however, are negligible--counter to expectation. Once other aspects of socioeconomic background are controlled, home ownership and size of home (number of rooms) have little effect on the attitudinal measures and deportment, but they do affect all four test scores. Father's education tends to dominate the other background variables in shaping the attitudinal variables and the test scores, but race also has a strong negative impact on the test scores. It should be noted, however, that the measure of parental occupation in the HSB is relatively crude; it is based on 14 broad occupational categories rather than the detailed census categories. Further, the occupational category describing the parent's occupation was collected from the youth, not the parent. Measurement error due to this fact probably deflates all coefficients and correlations involving parental occupation. Use of the broad occupational categories also affects the accuracy of measuring the youth's occupational expectation.

Especially in the equations for deportment, and to somewhat lesser extent in the equations for self-esteem, work values, and occupational exceptation, the large number of nonsignificant coefficients with a sample as large as the HSB sample suggests that too many collinear background variables have been included in the specifications. To help clarify the results, five of the variables were combined into a family socioeconomic index, and home ownership and size of home were dropped from the specifications. The family SES measure was constructed by averaging standardized scores of mother's and father's occupation and education and the index of family possessions. All 10 equations were rerun with this specification. The results are displayed in table 3. The reduction in number of independent variables does help to emphasize the importance of family status, since most of its effects now are aggregated into a single coefficient. However, the single index of family status masks the fact

BEST COPY AVAILABLE

TABLE 3

CROSS-SECTIONAL AND LONGITUDINAL EFFECTS OF BACKGROUND AND PERSONAL CHARACTERISTICS ON TEN SPECIFIED OUTCOMES -- AGGREGATED SES INDEX

		Dependent Variables									
		Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Ed. Expect.	Occ. Expect.	Deport-ment Index	Self-esteem	Locus of Control	Work Value
Intercept	CROSS SEC	54.499***	56.215***	59.096***	54.800***	17.024***	36.261***	0.969***	-0.004	-0.250***	0.024
	LONGIT	10.810***	12.401***	22.444***	32.266***	7.114***	26.545***	1.021***	-0.070	-0.142***	0.002
	RATIO	5.042	4.533	2.633	1.701	2.004	1.370	0.949*	1.193	1.013	9.674*
Lagged dependent variable	LONGIT	0.853***	0.819***	0.663***	0.453***	0.527***	0.289***	0.467***	0.790***	0.444***	0.290***
Gender (1=Female)	CROSS SEC	1.668***	-1.094***	-2.396***	1.329***	0.242***	9.364***	-1.360***	-0.051***	0.147***	-0.176***
	LONGIT	0.396***	-0.632***	-0.937***	0.754***	0.079**	5.741***	-0.913***	-0.008	0.090***	-0.131***
	RATIO	4.215	1.732	2.557	1.764	3.051	1.631	1.490	6.701	1.631	1.342
Race (1=Black)	CROSS SEC	-5.721***	-5.065***	-7.414***	-3.556***	0.7[illegible]***	2.007***	-0.126	0.219***	-0.060***	0.200***
	LONGIT	-0.989***	-1.037***	-2.544***	-2.182***	0.316***	0.723	-0.283**	0.119***	-0.025	0.157***
	RATIO	5.794	4.882	2.915	1.630	2.419	2.886	0.446*	1.842	2.415	1.304
Ethnicity (1=Hispanic)	CROSS SEC	-4.647***	-4.299***	-5.063***	-3.166***	0.096	0.601	0.434***	0.067***	-0.130***	0.056**
	LONGIT	-0.622***	-0.929***	-1.273***	-1.526***	-0.088	-0.140	0.079	0.047*	-0.077***	0.056**
	RATIO	7.470	4.625	3.978	2.075	-1.096*	-4.295*	5.489	1.419	1.797	0.995*
Father not in household (1=Not in household)	CROSS SEC	-0.572***	-0.505*	-0.570**	-0.739***	2.063	1.137*	0.840***	0.024	-0.028	0.041**
	LONGIT	-0.232*	-0.013	-0.137	-0.669***	0.027	0.713	0.456***	0.015	0.026	0.031*
	RATIO	2.472	37.436*	4.151	1.105	2.363	1.596	1.842	1.521	1.100	1.319
Mother not in household (1=Not in household)	CROSS SEC	-2.793***	-2.362***	-2.559***	2.459***	-0.403***	-1.343	0.550***	-0.048	-0.107***	-0.101***
	LONGIT	-0.978***	-0.733***	-1.074***	-1.439***	-0.245***	-1.259	0.048	-0.023	-0.066***	-0.070***
	RATIO	2.854	3.221	2.382	1.709	1.644	1.067	11.533*	2.100	1.625	1.448
Socio-economic Index	CROSS SEC	4.304***	4.621***	3.633***	3.294***	1.426***	6.967***	-0.128	0.084***	0.160***	-0.001
	LONGIT	0.857***	1.452***	1.517***	1.931***	0.646***	4.630***	0.006	0.048***	0.097***	-0.012
	RATIO	5.004	3.183	2.396	1.706	2.202	1.489	-20.039*	1.752	1.724	0.055*
Number of Siblings	CROSS SEC	-0.393***	-0.241***	-0.323***	-0.304***	-0.082***	-0.271***	0.090***	-0.011***	-0.019***	-0.012***
	LONGIT	-0.089***	-0.081***	-0.106***	-0.182***	-0.035***	-0.174*	0.034*	-0.005	-0.010***	-0.005*
	RATIO	4.415	2.958	3.054	1.674	2.329	1.557	2.806	2.306	1.961	2.198
Log of Family Income	CROSS SEC	-0.165	-0.099	-0.069	-0.103	-0.071	0.216	0.304***	0.057***	0.052***	0.067***
	LONGIT	0.073	0.051	-0.292*	-0.110	-0.040	0.387	0.211**	0.028*	0.026*	0.067***
	RATIO	-2.255*	-1.934*	0.235*	0.935*	1.753	0.560*	1.441	2.001	2.011	1.301
	AVE RATIO	4.661	3.091	3.008	1.670	2.231	1.656	2.630	2.324	1.706	1.409
	SD RATIO	1.490	1.055	0.649	0.249	0.400	0.532	1.522	1.504	0.334	0.321
	EST. BETA	0.822	0.723	0.679	0.404	0.555	0.419	0.650	0.619	0.441	0.330
	EST. θ	-0.098	-0.162	-0.194	-0.453	-0.295	-0.435	-0.215	-0.239	-0.410	-0.554
	R-SQ, C SEC	0.261	0.215	0.236	0.110	0.104	0.091	0.036	0.022	0.083	0.031
	R-SQ, LONGT	0.745	0.656	0.563	0.289	0.434	0.161	0.182	0.161	0.255	0.110

* p ≤ .01 on cross-sectional and longitudinal coefficients.
Excluded from calculation of average and standard deviation of ratios on "ratio."
** p ≤ .001.
*** p ≤ .0001.

Table 3--Continued

NOTE: The notation on the rows of the table are defined as follows:

CROSS SEC = cross-sectional coefficients

LONGIT = longitudinal coefficients

RATIO = ratio of cross-sectional to longitudinal coefficients

AVE RATIO = average of the ratios within the corresponding column (excludes outliers marked by *)

SD RATIO = standard deviation of the ratios within the corresponding column (excludes outliers marked by *)

EST BETA = estimated regression coefficient for lagged dependent variable using average ratio (see text)

EST B = estimated constant in the corresponding differential equation using average ratio (see text)

R-SQ, C SEC = R-square for cross-sectional equation

R-SQ, LONGT = R-square for longitudinal equation that father's education is by far the most important component of family status.* Further, the test score equations all contain highly significant coefficients on variables omitted from the specification reported in table 3. Finally, the ratios of cross-sectional to longitudinal coefficients in table 3 do not exhibit any more stability than in the expanded equations. Consequently, assessment of school effects to be reported presently will use the full complement of exogenous control variables. It might be preferable to use a different specification for each equation, but expected gain from this strategy probably does not offset the increase in complexity entailed in keeping track of which variables appear in which equations.

Reflections on the Dynamic Model

There is no doubt that learning is a process that occurs over time; hence, an important aspect of expressing what we think we know about learning in a formal model must include explicit expression of the dynamics of learning. This section uses a standard mathematical method--differential equations--to develop a highly simplified first approximation. The value of this development is that it shows the correspondence between widely used regression models and learning processes as they occur over time. Referring to cross-sectional studies of school effects, Alexander, McPartland, and Cook (1981) write:

> Consequently, it is difficult to draw clear conclusions from existing literature. Studies that omit controls for pre-entry performance levels (on standardized tests) or use as proxies student SES characteristics probably overestimate school effects; those that use cross-sectional data in lieu of pre-entry-level data may well underestimate them. Few assessments in this literature deal convincingly with this issue. (p. 7)

The interpretation of cross-sectional regressions developed here from the dynamic model shows that these regressions may be viewed as approximations to accumulated effects over the lifetime of the learning process. It will be seen in the next section of this chapter that the cross-sectional estimates of school effects are indeed biased--if the intent is to estimate effects of schooling over 2 years of high school--but that they are upwardly biased not downwardly biased. The cross-sectional estimates are not necessarily biased as estimates of accumulated schooling effects over a youth's lifetime, however.

Of course, in developing these interpretations, unlikely assumptions must be imposed, yet the data suggest that the model does provide a useful first approximation. The most valuable results of the model, however, are that they make the assumptions explicit and impose a coherent framework for interpreting cross-sectional regressions and longitudinal regressions calculated over different lengths of time between measurements.

---

*The crude nature of occupational measures in the HSB must be recalled, however, in noting the relative dominance of education over occupation.

Boardman and Murnane (1979) present a very general model of educational achievement. Their model allows for accumulated effects of schooling that may differ each year. The model proposed here is, in an important respect, a special case of their model. The present model is developed to aid interpretation of data analyses conducted with much more limited information than is implied by Boardman and Murnane's most general model.

Overall School Effects

Since publication of the EEOR, there has been some question as to whether outputs of schooling differ enough between schools to justify attempts to study the impact of attending different schools on those outcomes. Coleman and his colleagues (1966) report total between-school differences in verbal achievement and claim that the proportion of variance in verbal achievement that occurs between schools establishes a ceiling on the explanatory power of variables defined at the level of the school. Hauser (1971) summarizes findings from several data sets regarding proportion of variance in achievement and career expectations lying between schools in the absence of any controls. High estimates peak at about 35 percent for achievement test (TALENT data), but 20-25 percent is a more reasonable ceiling. Proportion of variance between-schools in career expectations and attainments tends to be lower than in achievement data, averaging between 10 and 15 percent (Hauser, Sewell, and Alwin 1976).

The importance of examining between-school effects in various outcomes has been obscured by the frontal attack on the variance partitioning methods used in early studies of school effects. There are at least three reasons why initial examination of between-school effects is important. The first is a matter of research strategy. To the degree that between-school variance in a dependent variable y is restricted, the variance of those independent variables that generate between-school differences in y must also be restricted (otherwise the between variance in y would not be restricted). In statistical estimations of paramaters, restricted variance in the x variables produces estimates with high sampling error. In the limit as the between-school variance of x approaches zero, the sampling error of the coefficient of x approaches infinity. Thus, if there is little between-school variation in outcomes, one may fairly conclude that the search for effective schooling practices should focus on explanatory factors that vary within schools.

A second reason for investigation of between-school effects is to provide a basis for comparison of results in which regressors describing school characteristics are used to predict individual level outcomes. Since it is always conceivable that some school charateristics have been excluded from such analysis, comparison of effects of a set of school dummy variables to effects of explained by explicit measures of school characteristics can provide an important clue regarding whether some important school charateristic has remained unmeasured.

Finally, thoughtful observers of educational processes persistently have claimed that school eth s (Brookhover et al. 1979), student culture (Coleman

1961; Coleman et al. 1966; McDill and Rigsby 1973), or school demographics (Coleman et al. 1966), among other factors, have strong influence on cognitive achievements. If little or no between-school variation on the outcome occurs, however, it is unlikely that such "contextual effects" are operating. Of course, it is possible that school context is important but it is so homogenous among schools that it does not produce large between-school variances in the outcomes that it affects. In this case, the first reason for examining between-school variances must be recalled. Discovery of the effects of a school level ethos, culture, or other such factors cannot proceed effectively if schools do not vary with respect to school ethos or culture.

Numerous critics of input-output studies of schooling have claimed that inadequate controls for differences among students at input invalidate the conclusions of such studies (e.g., Armor 1972; Bridge, Judd, and Moock 1979). The elementary change model proposed here, however, offers a substantive interpretation of cross-sectional differences among schools under control for status background. Under the assumption that quality of schooling (if not the specific school) remains constant over a student's schooling, the change model suggests that cross-sectional differences between schools under control for status background can be interpreted as the accumulated effects from beginning of schooling through the end of high school, net of socioeconomic background. In this view, the cross-sectional coefficients are not wrong, they simply index different effects than do the longitudinal coefficients.

This type of interpretation depends critically on two key assumptions:

1. Dummy variables for high schools give reasonable approximations of the quality of the schools that one has attended since beginning school.

2. The socioeconomic background variables used as controls are, in fact, exogenous to school quality.

There is some reason to suppose that assumption one is a rough approximation to reality. Although each youth may attend several schools during the time starting with kindergarden and ending with high school graduation, the quality of the school he or she attends is likely to be relatively homogeneous as compared to variations in school quality overall. The combined facts that public schools generally are neighborhood schools (bussing to achieve racial integration not withstanding), that neighborhoods tend to be segregated by socioeconomic status, and that socioeconomic status changes slowly and generally within a restricted range supports the contention that the quality of schools to which an individual is exposed is relatively constant. In the final conclusion, of course, the degree of homogeneity over time in schooling quality is an empirical question--one for which there currently exists little data.

The assumption that socioeconomic background is exogenous to the quality of school one's child attends appears reasonable upon considering the content of the socioeconomic background variables. It is hard to imagine that any feature of the school that one's offspring attends could influence, to more than a trivial degree, the highest level of education one attains, the job one holds, or the family income. Although the school may have some small influence on acquisition of possessions, such as a hand calculator or books, most of the items in the possessions index (e.g., number of automobiles, video tape recorder, television) seem relatively immune to such influences. Similarly, home ownership and number of rooms in one's home are unlikely to be influenced by the school one's child attends. There is no chance that gender, race, or ethnicity is affected by the school one attends. While these arguments appear to state the obvious, the debate cver the order of entry of variables into school effects equations that followed publication of the EEOR suggests that it is important to make them explicit.*

Table 4 presents proportions of between-school variance in the 10 outcomes. Three sets of estimates are given, one with no control variables (total proportion of between-school variance), one that includes all the exogenous variables but not the lagged dependent variable, and one including all exogenous variables and the lagged dependent variable. In view of the strong objections voiced against entering socioeconomic background variables into regression equations before entering school variables, partial correlations for school effects also are reported. These are analogous to net effects, the partial correlation seldom differing very much from the corresponding partial standardized regression coefficient. For comparative purposes, the partial standardized regression coefficients are displayed in table 4. Partial correlations corrected for loss of degrees of freedom also are displayed. The importance of this adjustment is clear on comparing the adjusted to the unadjusted values. The differences are quite large.

The table corroborates many findings in previous data. In the absence of controls, the proportion of variance between schools in all 10 outcomes is far less than the proportion within schools. The maximum proportion is nearly 24 percent for verbal achievement, and the minimum is 5.65 percent for self-esteem. The proportion between schools is reduced dramatically when the controls are introduced. With the exogenous controls included and lagged dependent variables excluded, the proportion varies from nearly 11 percent for verbal test score to a minimum of under 5 percent for self-esteem. These proportions are further reduced when the lagged dependent variables are added to the equations--ranging from a high of about 6 percent (civics test) to a low of about 1.5 percent (verbal test score).

The uncorrected partial correlations almost certainly give an inflated estimate of the size of school effects--the adjusted values being only about six-tenths as large as the unadjusted values. The partial betas correspond so closely to the partial correlations in most cases that no substantive interpretation of the data would be affected by the difference between them. However, since there is a close algebraic relation between the partial correlations and the partial betas, if the correlations require adjustment, so must the betas. Since an adjustment formula is not available for the betas, interpretation of the results should make use of the adjusted correlations.

---

*Coleman and his colleagues sometimes entered parental career expectations of their children before entering school characteristics. The argument that school may affect parental career expectations of their children is much stronger than parallel arguments relating to parental education, occupation, income, and possessions.

TABLE 4

R-SQUARE INCREMENTS, PARTIAL CORRELATIONS, AND STANDARDIZED REGRESSION COEFFICIENTS FOR OVERALL SCHOOL EFFECTS ON TEN SPECIFIED OUTCOMES

	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educational Expectation	Occupational Expectation	Deportment Index	Self-esteem	Locus of Control	Work Values
R-square increments										
No controls	.2397	.2241	.2239	.16166	.1670	.0899	.0789	.0565	.0942	.0604
Exog. controls	.1084	.0855	.0771	.0889	.0674	.0516	.0753	.0488	.0589	.0537
Exog.+lagged D.V.	.0156	.0224	.0273	.0601	.0363	.0460	.0497	.0356	.0398	0463
Partial correlations										
Exog. controls										
Raw	.3292	.3348	.3213	.3196	.2945	.2403	.2796	.2237	.2543	.2360
Adj.	.2611	.2684	.2505	.2483	.2134	.1235	.1913	.0848	.1499	.1143
Exog.+lagged D.V.										
Raw	.2474	.2555	.2519	.2909	.2537	.2348	.2465	.2061	.2310	.2293
Adj.	.1373	.1519	.1454	.2081	.1488	.1116	.1354	--	.1029	.0990
Partial beta										
Exog. controls	.3217	.3273	.3157	.3177	.3037	.2530	.2833	.2303	.2528	.2310
Exog.+lagged D.V.	.1899	.1937	.2263	.2724	.2132	.2308	.2317	.2034	.2126	.2145

NOTE. All R-square increments are significant at $p \leq .0001$.

In view of the heated debate over the relative importance of home and school in influencing cognitive achievement and the nearly universal conclusion that home influences dominate, comparative (adjusted) partial correlations are displayed in table 5. Two sets are shown: one without lagged dependent variables and one with lagged dependent variables. For each outcome in each set, two partial correlations are given. One summarizes the combined effects of all the background variables used previously (excluding the lagged dependent variable). A second partial correlation summarizes the effects of the 1,014 school dummy variables. In the calculations for which the lagged dependent variable was included as a regressor, a third partial correlation summarizing its effect also is given.

Comparison of SES effects to school effects tends to confirm conclusions of past research--the SES effects are larger. However, the discrepancies between SES and school effects are not nearly as large as one is led to believe by reference to variance partitions. This analysis does suggest that pessimistic conclusions about the importance of school effects are not warranted.* It must be emphasized, however, that the present analysis picks up all school differences, not just those that are due to measured school characteristics. With one important exception (Alexander, McPartland, and Cook 1981), other input-output studies have relied on explicit measures aggregated to the school level. (The next chapter of this report discusses results of this type).

There are interesting patterns in the partial correlations. First, accumulated SES effects (equations excluding the lagged dependent variable) are substantially larger than accumulated school effects. This imbalance is reduced considerably in the change equations (equations including the lagged dependent variable). The relative importance of school effects is higher for outcomes that one would expect to be influenced by schools--test scores and deportment in school. In all equations including the lagged dependent variables, the partial correlation for the lagged dependent variable far exceeds the other two, but this imbalance is greater for test scores and educational expectations than for the other variables.

One more aspect of the statistics reported in table 5 is of interest. The last two rows of the table report ratios of partial correlations calculated excluding the lagged dependent variable to those including it. While this exercise is not strictly justified in formal terms, it gives a close approximation to results that would be found using regression coefficients. These ratios give rough indication of the degree to which effects of SES and schooling are concentrated in early or late years of life. If the simple change model postulated here held exactly, the ratio of the regression coefficients corresponding to these partial correlations would be the same for SES and school effects; the ratios of partial correlations would be very close to equal. Obviously, the data do not support the change model in every detail,

---

*This is not to say that variance partitions should never be conducted, only that they must be interpreted with full understanding of their meaning and implications.

TABLE 5

PARTIAL CORRELATIONS COMPARING EFFECTS OF BACKGROUND TO OVERALL SCHOOL EFFECTS--
SINGLE EQUATION MODELS

	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educational Expectation	Occupational Expectation	Deportment Index	Self-esteem	Locus of Control	Work Values
No lagged D.V.										
Background	.4187	.3553	.3556	.437[illegible]	.3835	.2724	.2911	.1307	.2411	.1720
School	.2611	.2684	.2505	.2483	.2134	.1235	.1913	.0848	.1499	.1143
Ind. lagged D.V.										
Background	.1394	.1785	.1842	.1717	.2129	.1821	.1305	.0670	.1556	.1285
Lagged D.V.	.7927	.7278	.6333	.4139	.5140	.2581	.3680	.3667	.4181	.2920
School	.1373	.1519	.1454	.2081	.1488	.1116	.1354	--	.1029	.0994
Partial Correlation Ratios										
Background	3.004	1.990	1.931	2.548	1.801	1.496	2.231	1.951	1.549	1.339
School	1.902	1.767	1.723	1.193	1.434	1.107	1.413	--	1.457	1.150

may understate the importance of schooling.* Still, the model does afford a coherent basis for interpreting cross-sectional and longitudinal data within a single integrative framework. Under the stated assumptions, neither the cross-sectional nor the longitudinal regression estimates are wrong. They are simply estimates of effects accumulated over different time intervals.

The third and perhaps most important result of the differential equation analysis stems from the fact that critical assumptions underlying more or less standard regression procedures are made explicit. On noting these assumptions explicitly, it is clear that they provide, at best, rough approximations to empirical fact. Socioeconomic background variables do not all remain constant over the lifetime of an individual. Variation with regard to exposure to qualitative aspects of schooling is even more likely. Further, the effects of socioeconomic background and schooling on student outcomes probably do not remain constant over time. Recognizing that the assumptions of the model are not strictly accurate immediately suggests strategies for improving future research. In the short run, it would be useful to revise the differential equations to model explicitly the manner in which some of the status background variables change over time. For example, the concave downward shape of earnings streams is well-known and might be incorporated into the model. Also, the parameters of the differential equation should be allowed to vary with time--though this latter revision introduces substantial complexity into the statistical estimation. In the longer run, the model suggests the importance of gathering data at multiple time points throughout respondents' schooling career. Such data would support much more thorough investigation of the effects of home and schooling on school outcomes than currently is possible.

After completing analysis of the effects of socioeconomic background using the differential equation model, the model is applied to the study of school effects on the 10 outcomes. Analysis of overall school effects is conducted by using school dummy variables. Multiple partial correlations adjusted for loss of degrees of freedom are used to summarize the overall effects of schools under two conditions--control for the lagged dependent variable and the 14 background variables and under control for the 14 background variables only. In both cases, substantial school effects are observed. School effects are not as large as the combined effects of the 14 socioeconomic variables, but neither are they negligible as is often concluded. When the lagged dependent variable in each equation is omitted, the multiple partial correlation summarizing the combined impact of the over 1,000 school dummy variables average nearly 0.20. When the lagged dependent variable is included in the equations, school effects still average about 0.12. The ratio of these effects when the lagged dependent variable is excluded from the equations to the effects when it is included are again approximately constant, but the ratio for school effects is in every case somewhat smaller than the ratio for the

*It should be noted that this speculation contradicts a basic assumption of the elementary differential equation model that assumes all coefficients in the differential equation are constant over time.

socioeconomic background variables.* This observation suggests that the effects of background on the 10 variables declines with time while the effects of schools increases.

These results are important. They demonstrate that all schools are not equally effective in transmitting academic knowledge, attitudes, and deportment. This result conflicts with conclusions of most input-output studies, which find that effects of attending different schools generally are negligible when compared to the effects of different home backgrounds. One reason why the present result does not agree with past studies is that previous input-output studies depend on measured school characteristics to assess school effects; whereas, this study accounts for all (additive) effects of differences among schools, it does not depend on prior knowledge of which school characteristics are important.

There are two reasons why it is important to know that differences between schools are not due to differences among students when students enter the school. First, if schools do differ in quality, then it is important to adopt educational policies designed to upgrade the poorer schools and to assure that all youth have access to highest quality education. Such policies are important from an equity standpoint and from the standpoint of fully developing the potential of our Nation's human capacities. Second, knowledge that schools do differ in ways that cannot be accounted for by differences among their students helps to focus future research. The analyses in this chapter show that search for differences between schools is a potentially fruitful strategy for discovering characteristics and processes that are effective.

The results reported here also are important because they help to interpret standard statistical calculations in terms of a dynamic model of learning processes. Improved interpretation of this sort helps to point out the need for additional data and often suggests further revisions of the theoretical model. In the present case, for example, it is found that collection of data over more points in time would allow us to relax untenable assumptions such as the constant quality of schooling. It also suggests that developing models in which school and SES effects are allowed to vary over time may help to improve the realism of our theoretical models.

* These comments reference multiple partial correlations. Strickly speaking, however, the predictions of the differential equation model apply only to unstandardized regression coefficients. The prediction of constant ratio should be approximated by calculations involving partial correlations or standardized regression coefficients, however.

CHAPTER 5

EFFECTS OF SPECIFIC SCHOOL CHARACTERISTICS

It is one thing to show that residual differences among schools remain after control for background and lagged dependent variables. It is quite another to attribute those differences to specific features of schools. The number of school characteristics that potentially might affect schooling outcomes is embarrassingly large. The HSB school questionnaire alone contains over 600 variables, and the school means on many variables measured at the individual level may have important contextual effects on individual students (e.g., Coleman 1961; McDill and Rigsby 1972).

School Characteristics

Forty variables were selected from the HSB base year school file and from within-school means calculated from base year student data. In addition, the analyses include eight region dummy variables. These school characteristics are classified into seven broad categories. These categories and the variables contained in them are as follows:

- Sector--This category contains three dummy variables: one for "regular public schools," one for "regular Catholic schools," and one for "other private schools." The descriptive terminology "regular" and "other" stems from the HSB sampling design. Regular public and regular Catholic refer respectively to public schools and Catholic schools that were not oversampled in the stratified sample design. The other private schools refer to those that are neither Catholic nor "elite" private. The HSB sample design included a large oversampling of "elite" private schools, but when the compensating design weight was applied, the effects of these institutions did not appear in the analyses. Consequently, a dummy variable for elite private schools was eliminated from the regressions. The other categories of schools left in the residual are "black Catholic," "hispanic public," and "alternative schools."

  Although this report does not focus on the effects of sector on school performance, recent controversy regarding alleged superiority of the private schools makes it imperative to include sector in the analyses (Alexander and Pallas 1983; Cain and Goldberger 1983; Coleman, Hoffer, and Kilgore 1982; Heyns and Hilton 1982; Kilgore 1983; Goldberger and Cain 1982).

- School desegregation--Two variables describing court-ordered school desegregation are included in the analyses: percentage of students riding a bus to achieve racial balance and a dummy variable indicating whether the school was under a court order to desegregate (1=yes).

- Demographic and socioeconomic composition--Five variables describing demographic and socioeconomic composition of schools are included in the analyses: percentage of students black, percentage who are Hispanic, number of students, percentage of students from homes in which English is not spoken, and average family income. The last is the school average of student reports; the others are from the school questionnaire.

- Student context--Four variables describing educational characteristics of students in the school are included. These are proportion of the 1979 senior class attending college, proportion who dropped out of school, proportion of sophomores in the general curriculum track, and proportion in a vocational track. The rationale for including variables of this type stems from arguments to the effect that student context has an important impact on individual students. Students attending a school from which a high percentage attends college, for example, are themselves more likely to attend college. Such arguments have a venerable history in the social sciences (Blau 1960; Coleman 1961; Coleman et al. 1966; McDill and Rigsby 1972), but the strong warnings against overinterpretation of contextual effects (Robert Hauser 1974; 1971; 1970) must be answered before imputting of contextual effects is warranted.

- Teacher labor relations--Three variables describing the relationship between teachers and administrators in the schools are included: percentages of teachers belonging to National Education Association (NEA), percentage belonging to American Federation of Teachers (AFT), and occurance of a strike in the last 4 years. These variables are included on grounds that teachers are the chief resource in a school (e.g., Murnane 1975), and their relationship to school management is potentially important. Membership in unions and strikes are indicators of level of satisfaction and therefore may affect student outcomes. More direct measures of teacher characteristics would be desirable (such as SES, verbal ability, job satisfaction) but are not available in the current HSB data.*

- School policies--This classification includes a somewhat heterogeneous collection of variables that generally are viewed as legitimate instruments of school policy and practices. Six subcategories of policy variables are included:
  --Facilities and resources includes two facility variables: number of vocational facilities (e.g., occupational information center) and number of academic facilities (e.g., science laboratory). Two variables reflecting resources also are included in this group-- ratio of teachers to students and whether the last school tax levy passed (1=yes). Inclusion of facilities in analyses of these types has a long history, starting with the EEOR. Although few effects of facilities have been uncovered in past research,

*The consortium described in the foreword to this report is collecting data of this type.

it is important to include some measures of facilities. Schools spend a lot of resources on buildings and equipment; therefore, policy analyses should attempt whenever possible to evaluate the effects of such expenditures.

The ratio of teachers to students is included as a resource because school expenditures are so heavily saturated with teacher salaries. The measure is an indicator of the quantity of human resources in a school. The ratio of teachers to students is a rough indicator of the reciprocal of class size. It is more common to use the ratio of students to teachers in input-output analyses; however, inclusion of the ratio of teachers to students in this study is deliberate. Glass and colleagues (1982) summarize a vast amount of literature on the effects that class size has on learning. They conclude that the effects are real, despite many contradictory findings in the literature. They fit a nonlinear function between learning and class size using the logarithm of class size. The graph they published, however, looks very much like a hyperbola (e.g., $y = a+b/x$). There is good theoretical reason to prefer the hyperbola to the log function. A student with a tutor gets essentially 100 percent of the teacher's time. A student in a class of two students gets one-half of the teacher's time, and so on. Presuming that teacher attention promotes learning in a linear fashion leads to the conclusion that learning = a+b/class size. Hence, the teacher-to-student ratio is taken rather than the student-to-teacher ratio as in most studies. it must be noted, however, aggregating the reciprocal of class size is not the same as the teacher-to-student ratio.

--The second subgroup included under school policies contains variables describing teacher characteristics that are to a large extent influenceable by deliberate policy. These are the ratio of nonteaching staff to teachers, the ratio of teacher's aids to teachers, the proportion of the staff with a graduate degree, the salary paid to entry-level teachers (with bachelor's degree only), proportion of the staff with 10 or more years tenure, and average teacher absenteeism.

--The third group of policy variables is related to curriculum. Five variables are included: number of math and science courses, number of vocational courses, and number of nonacademic and nonvocational courses that sometimes have been referenced as "frills" in heated debate over school curriculum (e.g., courses in marriage and family, driver's training, and art). Additionally, participation in Upward Bound and in cooperative vocational education are included in the group of policy variables related to curriculum.

--Two variables are classified as being pedagogical in nature. These are requirement of a competency test for graduation and ability grouping of 10th grade English. Both of these policies have spawned much controversy. Some research has been conducted on the effects of ability grouping with no clear indication of the effects, though Bridge and his colleagues (1979) conclude that, on balance, ability grouping has a negative effect on achievement.

--Two variables describing student exposure to schooling are included here: number of hours of class time in the school year and average daily attendance. The importance of time spent on learning has been argued strongly (Wiley 1976; but see Karweit 1976 for a less enthusiastic view; also see commissioned reports such as that of the National Commission on Excellence in Education 1983).

--The final class of policy variables is school discipline. One variable is used--the school mean of the deportment index calculated from student data. This variable is a behaviorial summary rather than a policy variable per se. Demonstration of its effect, however, implies that policy should concentrate on achieving discipline. The importance of discipline has been stressed in a number of recent reports (Coleman, Hoffer, and Kilgore 1982; MacKenzie 1983; Purkey and Smith 1982), but arguments by Cain and Goldberger (1983) must be noted. They claim that discipline is more a result of individual student characteristics than it is of school policy. Thus, interpretation of any affects observed for the discipline variable must be done with caution.

- <u>School quality judgments</u>--Three indexes of opinions about the school on the part of its citizens are included. Two are student indexes aggregated to the school level, and one is an index of principals' reactions to a list of potential school problems. These variables are included on the assumption that school citizens are capable of evaluating the quality of their institutions in ways that matter regarding cognitive achievement and attitude development of students.

These school characteristics are viewed as representing a rough and imperfect causal hierarchy. In this hierarcy, sector is viewed as being unaffected by the other categories of variables, but it may affect them. Student demographic composition may be affected by sector in that public and private schools draw different proportions of students from different demographic categories (Coleman, Hoffer, and Kilgore 1982). On the other hand, demographic composition probably is not affected by the other groups of variables but may affect them. Student behavior context (e.g., college attendance) may be influenced by sector and demographics but is not likely to affect sector and demographics. Teacher labor relations may be affected by sector, demographics, and student context. However, the causal hierachy may break down here, because it is possible that labor relations affect student context (e.g., dropout rate). The school policy variables may be affected by sector, demographics, student context, and teacher labor relations. They may, in turn, affect quality judgments. Again, however, the causal hierarchy partially breaks down. The policy variables may, for example, affect student context and teacher labor relations.

These measures share many of the difficulties of measures of school characteristics used in previous input-output studies. In particular, the measures of school facilities give only a rough indication of the overall quality of facilities to which students attending a given school are exposed. There is no measure of the quality or size of these facilities, and there is no measure describing the most used facilities, classrooms. Further, there is no indication of usage levels and distribution of usage across students. In addition, the variables describing teachers provide only indirect indication of teacher quality. Assessment of the effects of different teachers could best be carried out by matching the characteristics of specific teachers under whom a student has studied to the student rather than by taking an average of all students in his or her school.* In similar view, it may be argued that it is the pattern of race relations within a school that is more important than variables such as percentage black, percentage bussed for racial balance, or presence-absence of court-ordered desegregation.

These limitations of th data are quite real, and interpretation of the results must be done in full cognizance of them. However, there is much to be learned from available data. The 40 variables included here do, in fact, account for a sizeable percentage of the total between-school variation in the 10 outcomes. The pattern of effects provides useful information in its own right and reveals intriguing clues to guide additional research, as will be seen in subsequent pages.

Interpretations of School Effects

The strategy in the analyses reported here is to enter these school characteristics as regressors and to predict the 10 outcome variables using the 14 background variables and lagged outcome as controls. There is some question in the literature about the utility and meaning to attribute to such analyses. A major point repeated in the literature is that a more immediate environment such as the classroom is more critical to learning and that aggregation to the school level masks important effects (Bidwell and Kasarda 1980; Spady 1976). On the other hand, some scholars agrue that schools are relatively self-contained systems and that school climate or ethos is a critical factor in school effectiveness (Brookover et al. 1979; Coleman 1961; McDill and Rigsby 1972). Although the work reported here must be considered exploratory, it is relevant to the view that school-level effects are important.

The issue of the appropriate level of aggregation of both independent and dependent variables is a complex one. Decisions regarding level of aggregation often appear arbitrary, and interpretation and comparison of results conducted at different levels often is confusing (see for example the controversy over Bidwell and Kasarda's [1975] district-level analysis).

---

* Alternative interpretations of such averages are discussed in the next subsection.

Interpretation of results conducted at varying levels of aggregation can benefit from some consideration of possible causal structures generating the observations. As a starting point, take an elementary model of effects at the individual level:

$$y_{ij} = a + bx_{ij} + u_{ij},$$

where

y_{ij} = outcome for person i, group j,
x_{ij} = independent variable value for person i, group j,
u_{ij} = distrubance, person i and group j, and
a,b = constants.

Aggregating both sides of this equation to the group level gives a model in which both dependent and independent variables are group-level variables:

$$\bar{y}_j = a + b\bar{x}_j + \bar{u}_j$$

If $\bar{u}_j$ is uncorrelated with $\bar{x}_j$, OLS estimates at the group level yield unbiased estimates of individual-level parameters.*

Next, suppose that the elementary model includes an additive contextual effect, as follows:

$$y_{ij} = a + bx_{ij} + c\bar{x}_j + u_{ij}$$

This case may be illustrated by teacher characteristics. One may be influenced, for example, by having a teacher with long experience (x_{ij}) but may also be influenced indirectly by attending a school in which the average amount of teacher experience is high (low)--x_j. Aggregating this equation produces the following:

$$\bar{y}_j = a + (b+c)\bar{x}_j + \bar{u}_j,$$

Thus, a school aggregate equation in this model estimates the combined individual and contextual effects of teacher experience.

Many analyses, as in the present case, aggregate the independent variables but not the dependent variables. When both the individual-level and school aggregate variables are measured explicitly, a direct test of the contextual model is conducted. In many cases, the measure of an aggregate variable is available but exposure of individual students is not. A two equation model of the following form may help in the interpretation of such analyses.

---

*Robinson's (1950) famous paper on the so-called "ecological fallacy" was about correlations, not regression coefficients. The group-level analysis certainly will not produce unbiased estimates of individual-level correlations, nor will it produce unbiased estimates of the standardized regression coefficients.

Suppose that--

$$x_{ij} = a + b\bar{x}_j + v_j \text{ and}$$

$$y_{ij} = c + dx_{ij} + e\bar{x}_j + u_{ij},$$

where the effect of $\bar{x}_j$ on x_{ij} exceeds that small part that can be attributed to the fact that x_j contains x_{ij} in it by definition. An example of this type of process might be the teacher's possession of a graduate degree. The first equation, in this case, expresses the hypothesis that the teacher of student i in school j is influenced to pursue an advanced degree by the average level of credentials of his or her colleagues. The second equation expresses the hypothesis that individual student achievement is affected by the level of training of his or her own teacher (x_{ij}) and by the average level in the school (x_j). Substituting the first equation into the second gives--

$$y_{ij} = (c+ad) + (e+bd)\bar{x}_j + (u_{ij}+dv_j),$$

which is a linear form in which the individual achievement appears on the left and school aggregate level of teacher training on the right. The coefficient on the aggregate teacher training (x_j) can be seen from this exercise to reflect the total effect of the school level of teacher training--the sum of its direct effect (c) and its indirect effect (bd) operating through influence of aggregate level of teacher credentials at a school on the decisions by individual teachers to pursue further training.

For expository reasons, these ideas have been developed with only one explanatory variable and its school-level mean. The reasoning generalizes in the obvious way to any number of variables.

Although this line of argument gives a coherent interpretation to various types of aggregate analyses, it does not obviate the need for caution in making such interpretations. Certainly, it is critical to include a number of controls in equations of the type just laid out, particularly in cases where "contextual effects" are postulated (Hauser 1971; 1974).

There are two important conclusions that emerge from these arguments. First, interpretation of aggregate-level analysis depends on the individual-level model. One generally cannot differentiate among competing individual-level models from the aggregate analyses. Second, reasons for discrepancies between aggregate and individual-level models may stem from the fact that different effects implicitly are being estimated depending on the type of aggregation.

School Effects--No Controls for Endogenous Variables

It is possible that some or even a sizeable portion of the overall school effects observed in the preceding chapter of this report are due to regional differences in educational practices and resources devoted to secondary education. Certainly, it is well known that per-pupil expenditures vary substantially by geographic location. Regional differences in effectiveness of schuoling are not very informative, however, because they indicate little about practices that produce effective schooling. Also, inclusion of dummy variables for regions uses up the degrees of freedom and adds complexity to the analyses. Therefore, preliminary analyses were conducted to determine whether it is necessary to control for region in examining school effects. These analyses produced significant increments in R-square over models containing only the 14 background variables and the lagged dependent variable. Partial correlations indexing combined effects of region are small, but they are too large to be neglected. Also, the inclusion of region has a modest effect on some other coefficients in the equations. Consequently, region dummies were included in most of the following analyses.

Analysis of the effects of specific school characteristics on the 10 student outcomes is presented in stages. This is because the multiple partial correlation can be used to summarize the combined effects of more than one independent variable in a uniform metric that can be compared (roughly) across sets of independent variables. The initial stages make use of the multiple partial correlation. Step one of the analysis examines the combined effects of all 40 measured school characteristics and compares those effects to the overall school effects as indicated by the multiple partial correlation calculated from the school dummy variables. The second step divides the school characteristics into seven broad categories and compares the effects of these sets of variables. Step three decomposes the combined effects of six sets of variables that are relatively easily influenced by deliberate policy of school personnel. Although the multiple partial correlations provide a heuristic mechanism for imposing some structure on a large analysis, they do not indicate the direction of effects and mask variations in the magnitudes of effects of component variables in a cluster whose combined impact is being assessed. The final step in the analysis, therefore, examines the regression coefficients associated with specific independent variables.

Table 6 presents multiple partial correlation coefficients describing (1) the combined effects of the school dummy variables--overall school effects--and (2) the combined effects of the 40 measured school characteristics. The first important observation in the table is that the combined effects of the measured school characteristics are of modest magnitude on all 10 outcomes. Although never as large as the estimated combined effects of SES (compare to table 4), these effects are uniformly significant statistically and large enough to be of substantive importance. The second interesting observation in table 6 is that the combined effects of the measured school characteristics are nearly as large in most instances as the overall effects of the school dummy variables--the largest discrepancy occurring for the civics test score. This observation implies that there are not necessarily unmeasured school characteristics that have such large effects on these 10 outcomes that their omission seriously biases effect estimates of the variables included.

It should be noted that the unadjusted partial correlations associated with the school dummy variables are in every case much larger than the adjusted values (see table 4). Whereas the combined effects of the measured school characteristics do not capture all of the residual (on SES and lagged dependent variable) variation between schools in the HSB sample, the

TABLE 6

COMPARISON OF PARTIAL CORRELATIONS FOR OVERALL SCHOOL EFFECTS TO PARTIAL CORRELATIONS FOR SPECIFIC LIST OF SCHOOL CHARACTERISTICS --SINGLE EQUATION MODELS

Dependent Variables	Overall School Effects	School Characteristics Effects
Verbal test score	.1319	.1158
Math test score	.1487	.1057
Science test score	.1387	.1112
Civics test score	.2045	.1158
Educational expectation	.1404	.1311
Occupational expectation	.1034	.0965
School deportment	.1363	.0776
Work values	.0994	.0529
Self-esteem	--	.0700

NOTES. 1. Table entries are multiple partial correlations adjusted for loss of degrees of freedom.

2. All (nonzero) table entries are significant at $p \leq .001$.

78

implication of this analysis is that they capture a sizeable proportion of the reliable variation.*

It must be emphasized that the near equality of the overall school effects and the combined effects of measured school characteristics do not assure that no important school characteristics have been omitted from the analysis. This obviously is not the case. The possibility of a spurious association always remains unless a well-designed experiment is undertaken. The HSB data do not, however, reveal strong reasons to suspect that school characteristics of major importance in determining the 10 outcomes under study here have been omitted from the present analysis.

The next step is to decompose the combined effects of measured school characteristics into components, each component consisting of subsets of related school characteristics. These broad categories correspond to the seven groups described in the preceding text: sector (public-private), school desegregation, demographic composition, student context, teacher labor relations, school policy instruments, and school quality ratings. In addition, the combined effects of region and individual SES are displayed. Table 7 presents the 90 multiple partial correlations.

Table 7 reveals several interesting patterns. As shown in every previous analysis, the socioeconomic background variables produce by far the most consistent and the largest multiple partial correlations. Their combined effects show a highly significant impact on every outcome, and those effects are substantially larger than the effects of any other subset of variables. However, the combined effects of background are only modestly larger than the combined effects of all measured school characteristics (compare row 1 of table 7 to column 2 of table 6).

In 6 of the 10 outcomes, regional differences in sophomore to senior change persist despite controls for an extensive list of explicit school characteristics. Regional differences occur for all four test scores, for school deportment, and for locus of control. The East-South Central and West-South Central regions display consistently negative effects on test score growth (coefficients not tabulated). Schools in the Mountain and Pacific regions display somewhat worse-than-average deportment.

Demographic composition of students, student context, and the 20 policy instruments have fairly consistently strong effects on the 10 outcomes. The importance of demographic composition and student context supports the findings of the EEOR, but the importance of the policy instruments contradicts

---

*In the case of self-esteem, the estimated combined effects of measured school characteristics exceeds the estimated effects of the school dummy variables. This is, of course, impossible. The estimates probably are due to the combined consequences of (1) calculating regression coefficients from a correlation matrix containing entries calculated from data present for each pair of variables and (2) the fact that the partial correlations are adjusted for loss of degrees of freedom in order to produce unbiased population estimates. The actual sample values do not display the anomaly described in the text.

TABLE 7

PARTIAL CORRELATIONS FOR TEN SPECIFIED OUTCOMES AGAINST SEVEN SETS OF SCHOOL CHARACTERISTICS, REGION AND SES--SINGLE EQUATION MODELS

Sets of Independent Variables	Dependent Variables									
	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educational Expectation	Occupational Expectation	School Deportment	Work Values	Self-esteem	Locus of Control
Socioeconomic background	.1485**	.1815**	.1909**	.1713**	.2134**	.1889**	.1270**	.1287**	.0728**	.1542**
Region	.0469**	.0323**	.0466**	.0599**	.0114	.0153	.0431**	--	.0153	.0392**
Sector (private-public)	.0179	.0204	--	.0191*	.0195	.0137	--	.0331**	--	--
School desegregation	.0191*	.0055	.0248**	.0037	--	--	.0115	--	.0087	--
Demographic composition	.0312**	.0307**	.0312**	.0226**	.0294**	.0341**	.0146	.0135	.0278**	.0216*
Student context	.0287**	.0316**	.0295**	.0360**	.0518**	.0374**	.0064	--	.0100	.0050
Teacher labor relations	.0164	.0130	.0230*	.0085	.0073	.0149	--	--	.0037	.0110
School policies	.0412**	.0340**	.0500**	.0589**	.0512**	.0345**	.0451**	.0237	.0115	.0442**
School quality ratings	.0150	.0138	.007[illegible]	--	.0150	.0152	.0184*	--	--	.0142

* significant at $p \leq .01$.
** significant at $p \leq .001$.

NOTE. 1. Lagged value of each outcome is included in its equation as a control.

2. Table entries are multiple partial correlations adjusted for loss of degrees of freedom.

conclusions of the EEOR. In large measure, however, the discrepancy arises from the fact that the 20 policy variables analyzed here contain variables that are not included in the EEOS data (more discussion of these findings will be presented in subsequent pages). Effects of school desegration are uniformly small, reaching statistical significance in only two cases: verbal test score and science test score. Teacher labor relations and the school quality ratings do not exhibit large effects on any of the outcomes; most of their coefficients are statistically insignificant. Again, the imprecise nature of many of these variables and the incomplete coverage of variables that one would like to include in a model of this sort must be recalled.

In view of the strong claims offered by Coleman, Hoffer, and Kilgore (1982) that private schools are more effective than public schools, the lack of strong impact of sector on any of the outcomes is noteworthy. In only one case are the combined effects of sector statistically significant, that of work values. The combined sector effects on work values are due almost entirely to strong depressive effects of the "other private" schools on work values. Although Coleman and his collaborators would claim that separate equations must be estimated within sector in order to capture sector x background interactions, available data on base year HSB do not support this contention (see Cain and Goldberger 1983). Although a change model with sector x background interactions should be estimated with base year and first follow-up of the HSB data, the results here do not support the large sector effects claimed by Coleman and his collaborators. The absence of sector effects on deportment is especially noteworthy in view of the claim by Coleman and colleagues that an orderly atmosphere is one of the chief mechanisms by which private schools produce superior academic achievement.

Since the equations on which the calculations in table 7 are based do include some sets of variables that might act as mechanisms by which private sector schools produce superior academic achievement and influence the other 6 outcomes, the coefficients reported there do not capture the total effect of sector. Equations in which region, desegregation, demographic composition, and student context are controlled, but teacher labor relations, the 20 policy instruments, and school quality ratings are not included, give a better indication of the total effect of sector. These calculations reveal results that are essentially identical to those reported in table 7 Sector effects are negligible. On the other hand, when only the socioeconomic background lagged dependent variable and region are controlled, sector effects do appear. Taken together, these patterns suggest that sector differences in academic growth and changes in attitudes and behavior are due primarily to differences between sectors in demographic composition and student context. Since the student context subset of variables contains proportion of students in vocational and general tracks, the results here are roughly consistent with claims that curriculum track (at the individual level) is an important reason for sector differences in academic achievement (Alexander and Pallas 1983). These speculations deserve to be pursued at length, but the scope of the present report precludes further attention to them.

The absence of strong effects of school desegregation suggests that strong fears of dire consequences stemming from this social experiment are not justified. While effects of desegregation are statistically significant with respect to two outcomes (verbal test score and science test score), the magnitude of these effects is not large.

Table 8 displays a breakdown of the effects of the 20 policy instruments into 6 subsets: resources and physical facilities, teacher and staff characteristics, curriculum, pedagogy, time in school, and school average deportment. None of the subsets show strong effects over more than six of the outcomes. The curriculum variables and average school deportment have the most consistently significant effects. Curriculum has a relatively strong effect on all the test scores except mathematics. It also affects educational expectation and locus of control. Deportment affects all the test scores except verbal; it also affects educational expectation and individual-level school deportment. This latter effect is the only significant effect of the 20 sets of policy instruments on individual deportment. This finding suggests that specific disciplinary policies and practices in schools account for school effect on individual school deportment.

The effects of curriculum and deportment on academic growth and on some of the other outcomes is encouraging, because these aspects of schooling are subject to deliberate policy shifts designed to achieve more fully educational goals. Absence of effects of class time (at the school aggregate level) also is noteworthy in view of the strong claims made regarding the positive influence of time on task in academic work (e.g., Karweit 1976; Wiley 1976) and the position of recent policy analysis such as that reported by the National Commission on Excellence in Education (1983). Absence of effects of teacher credentials, teacher salaries, teacher-student ratio and other staff characteristics also is noteworthy. Apparently, these formal aspects of personnel attributes are not as important in determining schooling outcomes as are the school processes, that are implied by the importance of curriculum and deportment (or disciplinary climate). It should be noted, however, that analyses of the EEOS do suggest that teacher verbal ability and socioeconomic characteristics are important. Absence of strong effects of physical facilities and resources are in accord with past findings. The absence of these effects in a large sample of longitudinal data helps to confirm that large expenditures on lavish physical equipment will not have commensurate payoff in affecting academic achievement and work-related attitudes and behaviors.

The pessimistic conclusions of the EEOR and numerous follow-up studies that between-school differences regarding inputs do not affect student outcomes tended to generate an air of futility among educators. As Wiley and others were quick to point out, absence of between-school differences in academic achievement do not imply that schools are ineffective, as many were quick to conclude. However, the general sense of ineffective schools persisted. The analyses presented to this point have done much to dispel the view that between-school differences in academic achievement and six work-related attitudes and behaviors are entirely due to the background socioeconomic status of students. In the previous chapter it was shown that the overall school effects on changes in these outcomes, although not as large as the combined effects of status background, are nevertheless substantial. It has also been shown in this chapter that a set of 40 measured school characteristics accounts for a sizeable proportion of the overall school effects as measured by a set of school dummy variables. These results are important

TABLE 8

PARTIAL CORRELATIONS FOR
TEN SPECIFIED OUTCOMES AGAINST SIX SETS OF POLICY INSTRUMENTS
--SINGLE EQUATION MODELS

Sets of Independent Variables	Dependent Variables									
	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educational Expectation	Occupational Expectation	School Deportment	Work Values	Self-esteem	Locus of Control
Resources and physical facilities	.0190	.0284**	.0145	.0064	.0122	.0259**	--	.0168	.0082	.0093
Teacher and staff characteristics	--	--	.0058	.0085	.0211*	.0146	.0150	.0140	.0040	.0172
Curriculum	.0316**	--	.0344**	.0255**	.0261**	.0174	.015[illegible]	--	.0098	.0264**
Pedagogy	.0071	.0111	.0251**	.0122	.0281**	.0061	.0071	.0102	--	--
Time in school	--	.0170	--	.0285**	--	--	--	.0045	--	.0237**
School mean deportment	.0131	.0153*	.0247**	.0376**	.0186*	.0052	.0387**	.0029	--	.0142

NOTE. 1. Lagged value of each outcome included in its equation as control.

2. Table entries are multiple partial correlations adjusted for loss of degrees of freedom.

because they tend to reduce general pessimism regarding the effectiveness of school policies in shaping student outcomes and because they indicate that there exists sufficient between school variation in outcomes to render input-output studies of the type reported here one (of several) potentially fruitful strategy for identifying effective school practices.

The multiple partial correlation analysis has been quite useful in these analyses, because it condenses an immense amount of information into a summary form that is relatively easy to interpret. As with any summary statistic, however, multiple partial correlations mask variation. They also do not indicate direction of effects. The preceding pages do not identify specific policies that may help to bring about educational goals. It is to issues of this sort that attention now shifts. Table 9 displays standardized regression coefficients for each school characteristic, and table 10 gives the corresponsing unstandardized coefficients.

Although many scholars have argued that standardized regression coefficients do not provide useful information, they do permit a rough comparison of the magnitude of the effects of independent variables with quite different measurement scales. It is possible to change the value of unstandardized coefficients arbitrarily by entirely trivial linear shifts in scale--for example, by changing from dollars to pennies or from centegrade to fahrenheit. With unstandardized coefficients alone, how does one make comparative judgments, for example, of the effectiveness of changing the number of science courses required to the effectiveness of ability grouping? The primary argument against the standardized coefficients is that their values depend capriciously on past policies that may be responsible for generating current values of standard deviations on which the standardized coefficients depend. Strictly speaking, this point is based on a correct observation about the character of standardized coefficients. In practical terms, however, standard deviations tend to be stable over time, and policies that would generate dramatic changes in standard deviations are unlikely to be enacted. Hence, as a rough guide in exploratory analyses, the standardized coefficients give important information. This is not to say that the unstandardized coefficients should not also be considered; they often do provide useful insight, especially when measurement scales are widely familiar (e.g., dollars or years of education). One of the problems of exclusive reliance on unstandardized coefficients is that judgments regarding the importance of different independent variables tend to be based on the level of significance rather than the size of the coefficients. In the final analysis, it must be emphasized that, policy decisions must be based on a variety of considerations that cannot be adequately captured in any coefficient of effect. Dollar cost and expenditure of "political capital" are among those considerations (see Hanushek and Kain [1973] and Coleman's [1973] reply to these criticisms).

The data in tables 9 and 10 show that school average family income has a small positive impact on math test score and on educational and occupational expectations. The proportion of students who are black tends to deflate verbal and science test scores and to increase educational and occupational expectations. Signs of the coefficients on the proportion of black students also are negative for math and civics test scores, though the coefficients are

BEST COPY AVAILABLE

TABLE 9

STANDARDIZED REGRESSION COEFFICIENTS INDICATING EFFECTS OF SCHOOL CHARACTERISTICS ON TEN SPECIFIED OUTCOMES — SINGLE EQUATIONS

	Dependent Variables									
Independent Variable	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deport-ment Index	Work Value	Self-esteem	Locus of Control
RESPUB1	-0.0003	-0.0173	0.0070	0.0035	-0.0242	0.[illegible]	-0.0115	-0.0102	0.0009	0.0002
RESCATH1	0.0027	0.0034	0.0102	-0.0250	-0.0103	-0.0079	-0.0120	0.0014	-0.0010	-0.0063
OTHPVT1	0.0091	-0.0109	-0.0013	-0.0056	-0.0206*	-0.0209	-0.0014	-0.0430***	-0.0065	-0.0066
STUBUSED	-0.0117*	-0.0021	-0.0161**	0.0050	0.0019	0.0021	-0.0127	0.0010	-0.0060	-0.0036
DESEGRE	0.0015	0.0074	-0.0077	0.0072	-0.0068	0.0078	-0.0028	-0.0068	-0.0110	0.0009
SCHSIZE	-0.0149*	-0.0106	-0.0019	-0.0117	0.0160	0.0009	0.0175	0.0056	-0.0173	0.0097
STUHISP	0.0050	0.0190*	0.0043	0.0193	0.0013	0.0318*	-0.0063	-0.0049	0.0033	0.0332**
STUBLACK	-0.0201**	-0.0339	-0.0353***	-0.0121	0.0282*	0.0292*	0.0021	0.0284*	0.0386***	0.0029
NOENGHOM	0.0007	-0.0033	0.0027	0.0059	0.0130	0.0119	-0.0100	0.0114	0.0110	-0.0250*
AFAMINC1	0.0060	0.0257***	-0.0057	0.0202	0.0273*	0.0434***	0.0133	0.0120	-0.0077	-0.0313
CLAEACOL	0.0206***	0.0170*	0.0052	0.0360***	0.0357***	0.0491***	-0.0073	0.0013	0.0021	0.0176
STUDROP	-0.0003	-0.0185***	-0.0252***	-0.0209*	-0.0110	-0.0117	-0.0129	-0.0028	0.0041	0.0058
PRO10GEN	0.0115	0.0003	0.0009	0.0009	-0.0230*	0.0161	-0.0070	-0.0164	0.0017	0.0033
PRO10VOC	0.0052	0.0029	0.0016	-0.0063	-0.0324***	-0.0028	-0.0110	-0.0007	-0.0032	0.0010
AFDT	-0.0097	-0.0000	0.0009	0.0010	-0.0068	-0.0121	0.0017	-0.0055	0.0036	0.0150
NEA	0.0038	0.0109	0.019[illegible]***	0.0091	-0.0069	0.0003	0.0070	0.0029	0.0126	0.0050
TABSTRIKE	0.0037	0.0019	-0.0052	0.0093	0.0000	0.0154	0.0022	0.0004	-0.0021	0.0033
NVOCFCL1	-0.0079	-0.0030	-0.0033	-0.0044	-0.0017	-0.0005	0.0003	0.0014	0.0049	-0.0005
NACAFCL1	-0.0047	-0.0112*	-0.0124*	-0.0063	0.0037	0.0057	-0.0002	0.0076	-0.0097	0.0040
VOTEPASS	-0.0016	-0.0144**	-0.0012	-0.0061	-0.0100	-0.0194*	0.0054	0.0114	-0.0061	-0.0065
TEACHSTU	-0.0001	-0.0016	-0.0011	-0.0004	0.0121	-0.0221*	-0.0014	0.0101	-0.0101	0.0156
STAFFRAT	0.0031	-0.0015	-0.0050	0.0106	-0.0076	0.0113	0.00[illegible]7	0.0041	0.0029	-0.0036
TAIDRAT	-0.0013	0.0015	0.0023	-0.0069	0.0019	-0.0016	0.000[illegible]	-0.0016	0.0030	0.001[illegible]
NA_ORPHG	0.0058	-0.0015	0.0107	0.0060	0.0031	0.0015	0.0138	0.0149	-0.0029	0.01[illegible]
AVETABSN	0.0008	0.0024	0.0034	-0.0067	-0.0015	-0.0115	-0.0001	0.0107	0.0133	0.0074
MORE10YR	0.0015	0.0011	0.0014	0.0023	0.0134	-0.0029	-0.0193*	0.0092	0.0043	-0.0038
BACHSALY	-0.0049	0.0042	-0.0048	-0.0056	0.0140*	0.0154	-0.0006	-0.0101	-0.0008	0.0098
MATHSCI1	0.0283***	0.0014	0.0294***	0.0234**	0.0094	-0.0133	0.0061	0.0021	-0.0021	0.0094
NVOCED1	-0.0072	0.0014	-0.0063	0.0025	-0.0153	-0.0032	0.0005	-0.0003	-0.0034	-0.0153
NFAILS1	-0.0057	0.0011	-0.0037	-0.0214*	0.0031	0.0038	0.0062	0.0073	-0.0002	-0.0022
UPBOUND	-0.0041	-0.0033	-0.0045	-0.0033	-0.0012	-0.0046	0.0061	0.0078	-0.0160	-0.0241***
VOCEDSAC	0.0029	0.0054	-0.0006	-0.0052	-0.0203**	-0.0186*	0.0148	0.0039	-0.0036	-0.0049
GRADCOMP	0.0068	0.0101	0.0212***	0.0149	0.0127	0.0103	0.0057	0.0054	0.0070	0.0036
ABL10ENG	0.0016	-0.0028	0.0033	-0.0035	-0.0219***	-0.0[illegible]	-0.0104	0.0130	0.0054	-0.0010
AVEATEND	0.0054	0.0054	-0.0023	0.0149	-0.0057	[illegible]	-0.0057	0.0098	0.0052	0.0257**
CLASTIME	-0.0016	-0.0117*	-0.0057	-0.0252***	-0.0014	0.0058	0.0009	-0.0069	-0.0042	0.0122
NONDEPRT	-0.0099	-0.0131*	-0.0225***	-0.0432***	-0.0190*	-0.0102	0.0489***	0.0009	0.0043	-0.0182
MSCHPSM1	-0.0040	-0.0029	0.0061	-0.0076	0.0102	-0.0038	0.0075	-0.0051	-0.0007	-0.0099
NSPACOL	0.0111	-0.0037	-0.0094	-0.0105	-0.0142	0.0006	-0.0262*	-0.0031	-0.0123	0.0005
MACHRATE	0.0102	0.0109	-0.0004	-0.0008	0.0005	0.0210*	-0.0209*	-0.0002	0.0033	0.0116

* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.

Table 9--Continued

NOTE: Definition of variables:

REGPUB1 = regular public school
REGCATH1 = regular Catholic school
OTHPVT1 = other private school
STUBUSED = percentage of students bussed for racial balance
DESE6 = school under court order to desegregate (1=yes)
STUHISP = percentage of students Hispanic
STUBLACK = percentage of students black
NOENGHOM = percentage of students who do not speak English at home
MFAMINC = school mean of family income
CLREGCOL = percentage of class of 1979 attending 4-yr college
STUDROP = percentage of students who dropped out of school
PRO1OGEN = percentage of sophomore class in the general track
PRO1OVOC = percentage of sophomore class in the vocational track
AFOT = percentage of teachers who belong to AFT
NEA = percentage of teachers who belong to NEA
TASTRIKE = date of last teacher strike
NVOCFCL1 = number of vocational facilities
NACAFCL1 = number of academic facilities
VOTEPASS = whether last school levy passed (1=yes)
TEACHSTU = ratio of teachers to students
STAFFRAT = ratio of nonteaching staff to teachers
TAIDRT = ratio of teacher aides to teachers
MA_ORPHD = percentage of teachers with MA or PhD
AVETABSN = average number of days teachers absent
MORE10YR = percentage of teachers with > 10 yrs experience
BACHSALY = entry-level teachers' pay
NMTHSCI1 = number of math and science courses offered
NVOCED1 = number of voc ed courses offered
NFRILS1 = number of nonacademic/nonvocational courses
UPBOUND = school participates in Upward Bound? (1=yes)
VOCEDSAC = school participates in co-op ed? (1=yes)
GRADCOMP = competency test required to grad? (1=yes)
ABL10ENG = 10th-grade English ability grouping? (1=yes)
AVEATEND = ave percentage daily attendance
CLASTIME = number of class hours per year
MSMDEPRT = school mean deportment index
PSCHPBM1 = principal school problem index (hi=many problems)
MSPHSCQL = school mean sophomore school quality index
MSCHRATE = school mean student school rating index

83

TABLE 10

UNSTANDARDIZED REGRESSION COEFFICIENTS INDICATING EFFECTS OF SCHOOL CHARACTERISTICS ON TEN SPECIFIED OUTCOMES — SINGLE EQUATIONS

	Dependent Variables									
Independent Variable	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deport-ment Index	Work Value	Self-esteem	Locus of Control
REGPUB1	-0.2178	-0.4780	6.2027	0.1014	-0.1738	0.0774	-1.1453	-0.0200	0.0191	0.0004
REGCATH1	0.1040	0.1263	0.4344	-1.0600	-0.1106	-0.7669	-0.2426	0.0042	-0.0031	-0.0182
OTHPVT1	0.4743	-0.6039	-0.0761	-0.3247	-0.2956*	-2.7602	-0.0360	-0.1743***	-0.0279	-0.0061
STUBUSED	-0.0140*	-0.0027	-0.0226**	0.0070	0.0007	0.0068	-0.0004	0.0001	-0.0006	-0.0003
DESEGRE	0.0335	0.1700	-0.1066	0.1746	-0.0496	0.4339	-0.0293	-0.0115	-0.0197	0.0014
SCHSIZE	-0.0002*	-0.0001	-0.0000	-0.0601	0.0000	0.0000	0.0001	0.0000	-0.0000	0.0000
STUHISP	0.0040	0.0137*	0.0032	0.0142	0.0002	0.0532*	-0.0020	-0.0002	0.0002	0.0017**
STUBLACK	-0.0073**	-0.0015	-0.0147***	-0.0051	0.0029**	0.0278*	0.2004	0.0000*	0.0012***	0.0001
NOENGHOM	0.0045	-0.0022	0.0019	0.0041	0.0023	0.0190	-0.0033	0.0006	0.0006	-0.0012*
NFAMINC1	0.0114	0.0513***	-0.0120	0.0425	0.0142*	0.2004***	0.0122	0.0018	-0.0012	-0.0002
CLREGCOL	0.0007***	0.0000*	0.0025	0.0170***	0.0022***	0.0527***	-0.0015	0.0000	0.0000	0.0006
STUDROP	-3.0000	-0.0180***	-0.0271***	-0.0225*	-0.0031	-0.0287	-0.0060	-0.0002	0.0003	0.0004
PRO100EN	0.0031	0.0024	0.0003	0.0027	-0.0017*	0.0111	-0.0009	-0.0004	0.0000	0.0001
PRO10VOC	0.0020	0.0000	0.0007	-0.0027	-0.0034***	-0.0027	-0.0020	-0.0003	-0.0001	0.0000
AFOT	-0.2161	-0.0181	0.0227	0.0446	-0.0419	-3.6050	0.0189	-0.0096	0.0065	0.0260
NEA	0.0676	0.2050	0.3740***	0.1794	-0.0336	0.0141	0.0669	0.0041	0.0183	0.0067
TASTRIKE	0.0957	0.0506	-0.1407	0.2664	0.0568	1.0971	0.0280	0.0165	-0.0044	6.0064
NVOCFCL1	-0.1146	-0.0504	-0.0536	-0.0700	-0.0060	-0.3106	0.0019	0.0016	0.0057	-0.0007
NACAFCL1	-0.0573	-0.1450*	-0.1694*	-0.0056	0.0125	0.1764	-0.0404	0.0072	-0.0097	0.0037
VOTEPASS	-0.0354	-0.3320**	-0.0202	-0.1474	-0.6590	-1.0735*	0.0572	0.0194	-0.0109	-0.0107
TEACHSTU	-2.3695	-0.4092	-0.3504	-2.7146	0.9669	-16.3339*	-9.1909	9.4101	-0.2404	0.3436
STAFFRAT	0.0025	-0.0012	-0.0044	0.0393	-0.0016	0.0225	[illegible]	[illegible]	0.0002	-0.0002
TAIDRAT	-0.0243	0.0297	0.0450	-0.1400	0.0096	-0.0756	0.2035	-0.0023	0.0045	0.0023
MA_ORPHD	0.0021	-0.0006	0.0045	0.0325	0.0003	0.0014	0.9025	0.0004	-0.0001	0.0005*
AVETASAN	0.0023	0.0074	0.0112	-0.0219	-0.0012	-0.0053	-0.0002	0.0024	0.0032	1.0016
MORE10YR	0.0036	0.0004	0.0006	0.0009	0.0014	-0.0028	-0.0035*	0.0003	0.0001	-0.0001
BACHSALY	-0.0000	0.0000	-0.0000	-0.0000	0.0000*	0.0002	-0.0000	-0.0000	-0.0000	0.0000
NATHSCI1	0.2011***	0.0148	0.3244***	0.2500**	0.0257	-0.3359	0.0290	0.0016	-0.0017	0.0070
NVOCED1	[illegible]946	0.0189	-0.0918	0.0360	-0.0551	-1.1871	0.0540	-0.0004	-0.0036	-0.0151
NFRILS1	[illegible]97	3.0140	-0.0502	-0.2896*	1.0104	0.1106	0.0363	0.0069	-0.0002	-0.0020
UPBOUND	-0.0016	-0.0699	-0.0996	-0.0736	-0.0060	-0.2297	0.9505	0.0120	-0.0272	-0.0361***
VOCEDSAC	0.0545	0.1062	-0.0119	-0.1199	-0.1047**	-0.0046*	0.1340	0.0056	-0.0055	-0.0070
GRADCOMP	0.1376	0.2132	0.4730***	0.2339	0.0701	0.5270	0.0552	0.0004	0.0115	0.0054
ABL10ENG	0.0300	-0.0549	0.0606	-0.1138	-0.1111***	-0.3052	-0.0930	6.0106	0.0002	-0.0025
AVEATEND	0.0090	0.0095	-0.0043	0.0276	-0.0026	-0.0167	-0.0046	0.0013	0.0007	0.0032**
CLASTIME	-0.0001	-0.0000*	-0.0004	-0.0019***	-0.9000	0.0010	0.0000	-0.0000	-0.0000	0.0001
HANDEPRT	-0.0090	-0.1243*	-0.2251***	-0.4324***	-0.0400*	-0.2313	0.2122***	0.0062	0.0032	-0.0124
PSCHPSN1	-0.1122	-0.0723	0.1500	-0.1979	0.0654	-0.2269	0.0049	-0.0093	-0.0013	-0.0175
NSPHSCOL	0.4612	-4.1614	-0.4360	-0.4874	-0.1607	0.0092	-0.5276*	-9.0101	-0.0419	0.0016
NSCHRATE	0.3381	0.3001	-0.3116	-4.0279	0.0009	1.7621*	-0.3349*	-0.0210	0.0009	0.0291

* $p \le .01$.
** $p \le .001$.
*** $p \le .0001$.

Table 10--Continued

NOTE: Definition of variables:

REGPUB1 = regular public school
REGCATH1 = regular Catholic school
OTHPVT1 = other private school
STUBUSED = percentage of students bussed for racial balance
DESE6 = school under court order to desegregate (1=yes)
STUHISP = percentage of students Hispanic
STUBLACK = percentage of students black
NOENGHOM = percentage of students who do not speak English at home
MFAMINC = school mean of family income
CLREGCOL = percentage of class of 1979 attending 4-yr college
STUDROP = percentage of students who dropped out of school
PRO10GEN = percentage of sophomore class in the general track
PRO10VOC = percentage of sophomore class in the vocational track
AFOT = percentage of teachers who belong to AFT
NEA = percentage of teachers who belong to NEA
TASTRIKE = date of last teacher strike
NVOCFCL1 = number of vocational facilities
NACAFCL1 = number of academic facilities
VOTEPASS = whether last school levy passed (1=yes)
TEACHSTU = ratio of teachers to students
STAFFRAT = ratio of nonteaching staff to teachers
TAIDRT = ratio of teacher aides to teachers
MA_ORPHD = percentage of teachers with MA or PhD
AVETABSN = average number of days teachers absent
MORE10YR = percentage of teachers with > 10 yrs experience
BACHSALY = entry-level teachers' pay
NMTHSCI1 = number of math and science courses offered
NVOCED1 = number of voc ed courses offered
NFRILS1 = number of nonacademic/nonvocational courses
UPBOUND = school participates in Upward Bound? (1=yes)
VOCEDSAC = school participates in co-op ed? (1=yes)
GRADCOMP = competency test required to grad? (1=yes)
ABL10ENG = 10th-grade English ability grouping? (1=yes)
AVEATEND = ave percentage daily attendance
CLASTIME = number of class hours per year
MSMDEPRT = school mean deportment index
PSCHPBM1 = principal school problem index (hi=many problems)
MSPHSCQL = school mean sophomore school quality index
MSCHRATE = school mean student school rating index

90

not significant at the 0.01 level. Proportion of students who are black also increases self-esteem and work values. The other demographic variables do not exercise strong effects on any of the outcomes. Number of students in the school has a consistently negative effect on all four test scores, but only one of the coefficients (on verbal test score) is statistically significant at the 0.01 level. These findings regarding effects of demographic factors are consistent with other research. The EEOR found negative effects of percentage black students, for example, and this result was one justification for school desegregation.

Of the student context variables, the percentage of the class of 1979 that attended college and the percentage of dropouts combine to affect all four test scores. Whereas both coefficients are not significant in all four test score equations, at least one of the two is significant in each of these four equations. The sign of the percentage attending college is positive in every case, and the sign on percentage of dropouts is negative in every case. Moreover, the percentage attending college has relatively strong positive effects on educational and occupational expectations. The only other important effect among the student context variables is the relatively large negative coefficient of proportion in a vocational track on educational expectation. Taken together, these results suggest that student context is a fairly important aspect in determining academic growth and career expectations, but it does not have h influence on self-esteem, deportment, work values, or locus of control. Understanding the mechanisms by which student context operates, however, depends on detailed information concerning student interactions--information not available in the HSB data set.

Among the curriculum variables, the most important effects are those of the number of math and science courses on the test scores. Three of four of these effects are statistically significant; all are positive. It is difficult to interpret the absence of a significant coefficient indicating the effect on math test score, but the other results are encouraging. Although none of the effects are of large magnitude, the fact that curriculum has the expected effects and that it is subject to the influence of policy decisions makes these findings particularly important. The view expressed by the National Commission on Excellence in Education (1983) that more academic subject matter should be required of high school students appears to be substantiated.

Of course, this conclusion rests on the implicit value judgment that it is desirable to raise test scores. Probably few persons would debate this objective, given that everything else remained unaffected. The fact that number of math and science courses does not exhibit significant effects on the nontest score outcomes studied here does, in fact, suggest that the possible undesirable side effects of increasing the number of required math and science courses are not a major concern.

In view of the negative impact of proportion in vocational track, the negative effects of a work-study program in a high school on both educational and occupational expectations are important. Apparently, emphasis on vocational study tends to reduce the level of career expectations. Interpretation of this conclusion is not straightforward. On the one hand, some would view such side effects of vocational study as unfortunate. The life-style and socioeconomic careers of individuals who are "cooled out" of higher education and corresponding high-status jobs may be markedly affected . . . in ways that many find unfortunate (Mortimer and Finch, forthcoming). Further, the overall quality of life for specific individuals who are steered away from higher education and of the general population may be adversely affected. On the other hand, some scholars argue that too many Americans attend college (Freeman 1976; Rumberger 1981).

School Effects--Control for Endogenous Variables

The analysis of the preceding section is predicated implicitly on the assumptions that the outcomes do not affect each other. For example, test performance does not influence educational expectation, nor does educational expectation affect test performance--or educational and occupational expectations do not affect each other. Such assumptions obviously cannot be imposed a priori with any confidence. It might be argued, however, that the school characteristics, socioeconomic background, and personal characteristics are exogenous to the 10 outcomes studied here. With this line of argument we are studying a reduced form that gives the total effects of school characteristics, background, and personal characteristics. In the context of a dynamic model of the 10 outcomes, the reduced form interpretation can only be sustained with respect to the total accumulated effects of school characteristics over one's schooling career; it is not a tenable interpretation for the effects of high school education between respondents' sophomore and senior years.

These points are derived from the specification of a simultaneous dynamic model of the following general form:

$$(1) \quad \dot{y} = Ax + By,$$

where

$\dot{y} = \frac{dy}{dt}$ = a Kx1 vector of derivatives of the outcome variables with respect to time,

y = a Kx1 vector of endogenous outcomes,

x = a Jx1 vector of exogenous variables assumed constant over time,

A = a KxJ matrix of coefficients assumed constant over time, and

B = a JxJ matrix of coefficients assumed constant over time.

Integrating this system (eq. 1) under the stated assumptions gives a solution that can be used in conjunction with longitudinal data to estimate the fundamental parameters in the matrices A and B (see Coleman 1968; Hotchkiss 1979; Arminger 1983):

$$(2) \quad y_t = A^*x + B^*y_{t-\ \ t},$$

where $A^* = (e^{B\Delta t}-I)B^{-1}A$ and $B^* = e^{B\Delta t}$. I is an identity matrix, and $e^{B\Delta t}$ is a matrix exponentiation (not defined by exponentiating the elements of B). Equation 2 obviously is a generalization of the single differential equations applied previously. If the matrix B is constrained to be diagonal, equation (1) represents a sequence of single equations. In that case, the matrix $B^* = e^{B\Delta t}$ also is diagonal so that single equation regression models containing only exogenous variables and lagged dependent variables on the right are appropriate.

If it is assumed, as above, that the initial values of y denoted by y_0 are all zero for every respondent, and Δt is set equal to t, then equation 2 reduces to

$$y_t = (e^{Bt}-I)B^{-1}Ax,$$

$$= A^*(t)x.$$

This result implies that regression estimates of total accumulated effects of the exogenous variables over the lifetime of the process are not affected by assumptions regarding feedback among the outcome variables. Certainly the interpretation of those regressions is affected, however, since the matrix B^{-1} appears in the expression defining the regression coefficients in $A^*(t)$.

On the other hand, estimates of accumulated effects of exogenous variables over the interval between respondents' sophomore and senior years in high school are potentially very much affected by the assumptions regarding effects of the endogenous variables on each other. Observing equation (2), it is apparent that regression estimates of the coefficients will depend on whether B^* is assumed to be diagonal. If B^* is assumed diagonal when in fact it is not, the degree of bias in A^* will depend on the degree to which B^* deviates from a diagonal matrix. Estimates of effects presented in previous sections of this chapter, therefore, are at best rough approximations.

This section presents estimates of the effects of school characteristics that were calculated using controls for endogenous as well as exogenous variables. Extensive research on the process of status attainment indicates that the 10 outcomes under study here do not comprise a complete set of endogenous variables that should be included as controls. Grade average and parental educational expectations of their child must, at minimum, be included in the set of endogenous variables (see Campbell 1983 for a recent review of status attainment research). Accordingly, three variables are added to the analyses--sophomore average grades (four-point scale) as reported by the student, mother's expectation that the youth attend college (1=yes, 0=no), and father's expectation that the youth attend college (1=yes, 0=no). These measures are not ideal. Grade average calculated from transcripts would be preferable to self-reported grades, but self-reported grades do frequently yield results that are comparable to those derived from transcript data (see Hotchkiss 1983 for example). Parental educational expectations would be better measured by the number of years of schooling the parent expects the youth to finish or an approximation thereof adjusted for degree points. Also, a measure of parental occupational expectations of their children would be desirable. These shortcomings are not fatal to the analyses, however. It is unlikely that the use of the preferred variables would alter the results in more than a marginal fashion.

The first issue to decide is whether the combined impact of school characteristics persists when the sophomore measures of the 13 endogenous variables (10 original outcomes plus grades and parental college expectations) are controlled. Table 11 presents the partial correlations to check on the combined effects of school characteristics using a simultaneous equation model of the general form defined by equation (2).

Comparing entries in the last column of table 11 to those in the last column of table 6 reveals no dramatic differences. Adding controls for 13 endogenous individual-level variables generally has reduced the estimates of school effects by a modest amount--averaging about 20 percent if the civics test score is omitted from the calculation. The additional controls reduced the partial correlation on the civics test by nearly 40 percent.

TABLE 11

PARTIAL CORRELATIONS FOR COMBINED EFFECTS
OF SCHOOL CHARACTERISTICS--SIMULTANEOUS EQUATION MODELS

	Partial Correlations	
Dependent Variables	Combined Background Variables	Combined School Characteristics
Verbal test score	.1048**	.1081**
Math test score	.1318**	.0893
Science test score	.1773**	.0924**
Civics test score	.0359**	.0700**
Educational expectation	.1569**	.1145**
Occupational expectation	.1287**	.0717**
Deportment index	.1095**	.0633**
Work values	.1220**	.0409
Self-esteem	.0487**	.0298
Locus of control	.0827**	.0498*

* $p \leq .01$.
** $p \leq .001$.

The primary reason for this reduction is that the lagged civics test score does not have the largest effect on senior year civics test; the lagged verbal test score does. Also, the lagged science test has nearly as strong effect on civics as does the lagged civics test score (see table 16). The implicit assumption used in the single equation analyses that B* is approximately diagonal is violated with respect to the civics test.

The reason for this anomoly is not clear. One possibility is that knowledge of civics and history increases more rapidly in high school than is true of the other subject areas. This hypothesis might be tenable in comparing civics to verbal and math achievement since the relative emphasis on civics in elementary school and junior high school probably is lower than in high school. However, the relative emphasis on science in elementary school and junior high school probably is also lower than in high school, but the same anomoly does not appear for the science test. Other explanations for these results with the civics test therefore must be considered. One likely possibility is that the HSB civics test is relatively unreliable, since it consists of only 10 items. The science test contains 20 items, the 2 math tests combined into 1 score for this report contain a total of 38 items and the 3 tests combined in this report to define the verbal achievement score contain a total of 58 items.

Table 12 displays a decomposition of the combined effects of school characteristics into the same categories of variables reported in table 7. Partial correlations reported in table 12, however, were computed with controls for the endogenous variables. Comparison of the entries in the two tables gives a direct indication of the impact of working with a simultaneous model. Results in the two tables are again quite similar. Control for the endogenous variables tends to reduce the magnitude of all correlations somewhat, but the main patterns observed in table 7 carry over into table 12. The important categories of school characteristics are demographic composition, student context, and the constellation of 20 policy instruments.

The most interesting effects of controlling for the endogenous variables appear when the 20 policy variables are broken down into 6 groups, as reported in table 13. Comparing table 13 to table 8, where effect estimates without controls for endogenous variables are reported, again shows that most of the patterns observed without the controls for the endogenous variables are preserved when the controls are included. The primary exception occurs with respect to effects of school mean deportment. Statistically significant correlations of modest magnitude with math and science test scores in the absence of controls declined to zero when the controls were added. Additionally, a significant partial correlation between school mean deportment and educational expectation in table 8 is zero in table 13, and a nearly significant correlation between school mean deportment and verbal test score in table 8 is zero in table 13. The original pattern implied that school mean deportment has a relatively pervasive effect on schooling outcomes related to employability. Apparently, however this conclusion is in error. What seemed to be effects of school mean deportment are picked up in the feedback effects of the simultaneous model. As will be seen momentarily, part of the reason for these shifts in effects of school mean deportment may be due to including individual-level deportment in the equations.

TABLE 12

PARTIAL CORRELATIONS--
TEN SPECIFIED OUTCOMES AGAINST SEVEN SETS OF SCHOOL
CHARACTERISTICS, REGION, AND SES
--SIMULTANEOUS EQUATION MODELS

	Dependent Variables									
Sets of Independent Variables	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educational Expectation	Occupational Expectation	School Deport- ment	Work Values	Self Esteem	Locus of Control
Socioeconomic background	.1048**	.1318**	.1773**	.0359**	.1569**	.1287**	.1095**	.1220**	.0487**	.0827**
Region	.0501**	.0440**	.0475**	.0568**	.0158	--	.0437**	.0126	.0200	.0348**
Sector (private-public)	.0177	.0185	--	.0054	.0133	.0172	--	.0288**	.0025	--
School desegregation	.0190*	--	.0270**	--	--	--	.0148	--	.0112	--
Demographic composition	.0294**	.0394**	.0447**	.0166**	.0384**	.0298**	.0097	.0050	.0276**	.0210
Student context	.0272**	.0291**	.0255**	.0288**	.0390**	.0286**	--	--	.0053	--
Teacher labor relations	.0189*	.0077	.0186*	.0089	.0142	.0129	--	--	--	.0068
Policy instruments	.0380**	.0263	.0427**	.0482**	.0446**	.0274*	.0502**	.0195	.0093	.0450**
School quality ratings	.0173	--	.0174	--	.0087	.0119	.0177	--	.0106	--

* p ≤ .01
** p ≤ .001

TABLE 13

PARTIAL CORRELATIONS FOR
TEN SPECIFIED OUTCOMES AGAINST SIX SETS OF POLICY INSTRUMENTS
--SIMULTANEOUS EQUATION MODELS

	Dependent Variables									
Sets of Independent Variables	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educational Expectation	Occupational Expectation	School Deport-ment	Work Values	Self Esteem	Locus of Control
Resources and physical facilities	.0161	.0259**	.0155	--	.0085	.0184	--	.0099	--	.0093
Teacher and staff characteristics	.0068	--	--	.0164	.0237*	.0155	.0160	.0093	.0074	.0265**
Curriculum	.0323**	.0096	.0318**	.0286**	.0288**	.0168	.0156	--	.0106	.0294
Pedagogy	.0034	--	.0262**	--	.0228**	--	.0098	.0087	--	--
Time in school	.0061	.0103	--	.0269**	--	.0022	--	.0060	--	.0214*
School mean deportment	--	--	.0095	.0235**	--	--	.0428**	--	--	--

* $p \leq .01$
** $p \leq .001$

$F = 1.835$
$F_c = 1.89$ @ .01

Tables 14 and 15 report standardized and unstandardized repression coefficients respectively, indicating effects of each school characteristic on each of the 10 outcomes. To assess the impact of controlling for the endogenous variables on these effect estimates, entries in table 14 should be compared to corresponding entries in table 9, and table 15 should be compared to table 10. The main patterns of effects observed in the absence of controls for endogenous variables remain in table 14 and 15. There are, in fact, no differences between the two sets of estimates that imply a need for reassessing conclusions based on the estimates baseo on the (implicit) hypothesis of no causal feedback loops, except in the case of the markedly reduced effects of school mean deportment. These reductions appeared in the partial correlations and therefore are to be expected in the regression weights.

Although feedback effects of the endogenous variables on each other are not the primary focus of this chapter, it is of interest to examine them briefly. Table 16 displays these coefficients--both standardized and unstandardized values. In view of the fact that control for endogenous variables reduced most effects of school mean deportment to near zero, the pattern of effects of the lagged individual-level deportment index is noteworthy. In fact, the individual-level deportment variable does have a statistically significant effect on two of the three outcomes for which significant effects of school mean deportment in the absence of controls for endogenous variables become essentially zero when the controls are added. These two outcomes are math test score and educational expectation. In the case of science test score, however, individual-level deportment does not have a significant effect --even though the effect estimate of school mean deportment changed from significant to near zero when controls for the endogenous varaibles were added.

A number of effects among the endogenous variables are of interest. Some of the most fascinating observations in the table are those regarding the effects of parents' college expectations for their children. As expected, both mother's and father's college expectations positively influence the number of years of education that youth expect to achieve. Mother's college expectation also has a positive effect on the status level of occupation the youth expects to attain. These findings correspond to repeated observations in the status attainment literature (Alexander, Eckland and Griffin 1975; Hauser, Tsai, and Sewell 1983; Jencks, Crouse, and Meuse 1983; Sewell and Hauser 1875). The effects of the youth's expectations on parents are even more interesting--both educational and occupational expectations held by youth for themselves have a stronger impact on both parent's expectations of the youth than the parent's expectations have on those of the youth. This pattern may be due in part to the fact that parental expectations were measured from youth's reports of those expectations--they are, therefore, parental expectations as perceived by youth. Presumably youth act on their own perceptions, so this method of measurement should not necessarily be viewed as a poor proxy for parent's reports. However, the pattern of effects reported here suggests that youth's perceptions of whether their parents expect them to attend college are heavily influenced by the amount of schooling youth expect to attain and by the level of job they expect to attain. Most status attainment research that examines career expectations has used youths' reports of parental expectations. It has generally been assumed in this work that parents affect youth, not the reverse. Since longitudinal data with multiple measurement points during high

BEST COPY AVAILABLE

TABLE 14

STANDARDIZED REGRESSION COEFFICIENTS INDICATING EFFECTS
OF SCHOOL CHARACTERISTICS ON TEN SPECIFIED OUTCOMES
— SIMULTANEOUS EQUATIONS

	Dependent Variables									
Independent Variable	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deport-ment Index	Work Value	Self-esteem	Locus of Control
RESPUB1	-0.0050	-0.0147	0.0075	0.0027	-0.0227	0.0030	-0.0153	-0.0065	0.0094	0.0026
RESCATH1	0.0091	0.0050	0.0051	-0.0113	-0.0058	-0.0038	-0.0136	-0.0061	0.0017	-0.0026
OTHPVT1	0.0077	-0.0040	0.0001	-0.0002	-0.0014	-0.0212	-0.0027	-0.0372***	-0.0076	0.0002
STUBUSED	-0.0111*	-0.0007	-0.0165**	-0.0005	0.0024	0.0021	-0.015	0.0031	-0.0066	-0.0030
SEXSEGRE	0.0033	0.0043	-0.0076	0.0027	-0.0052	0.0052	-0.0053	-0.0038	-0.0126	-0.0004
SCHSIZE	-0.0002	-0.0078	-0.0063	-0.0141	0.0116	0.0039	0.0168	-0.0029	-0.0148	0.0062
STUHISP	0.0055	0.0153	-0.0011	0.0176	0.0003	0.0262	-0.0074	-0.0064	0.0010	0.0289*
STUBLACK	-0.0080**	-0.0036	-0.0430***	0.0000	0.0413***	0.0265*	0.0066	0.0193	0.0377**	0.0003
NOENGHOM	0.0008	-0.0033	-0.0031	0.0064	0.0166*	0.0096	-0.0063	0.0060	0.0114	-0.0234*
NFAMINC1	0.0076	0.0351***	-0.0156	0.0128	0.0285**	0.0397***	0.0091	0.0170	-0.0105	-0.0002
CLRESCOL	0.0166**	0.0071	0.0009	0.0196	0.0259**	0.0373***	-0.0086	0.0001	0.0181	0.0069
STUDREP	-0.0110*	-0.0196***	-0.0210***	-0.0207**	-0.0101	-0.0093	-0.0111	-0.0035	0.0052	0.0008
PRO10GEM	0.0002	0.0053	0.0058	0.0138	-0.0173	0.0155	-0.0036	-0.0172	0.0023	0.0107
PRO10VOC	0.0051	0.0003	0.0058	0.0005	-0.0252**	-0.0011	-0.0096	-0.0091	-0.0021	0.0009
AFOT	-0.0100*	0.0015	-0.0006	-0.0014	-0.0110	-0.0124	0.0007	-0.0028	0.0023	0.0131
NEA	0.0030	0.0003	0.0149*	0.0096	-0.0091	-0.0030	0.0005	0.0027	0.0112	0.0016
TASTRIKE	0.0037	0.0020	-0.0046	0.0062	0.0004	0.0132	0.0006	0.0008	-0.0031	0.0016
NVOCFCL1	-0.0067	-0.0056	-0.0053	-0.0072	-0.0046	-0.0005	-0.0002	0.0025	0.0045	-0.0047
NACAFCL1	-0.0060	-0.0064	-0.0110	-0.0009	0.0079	0.0063	-0.0006	0.0002	-0.0091	0.0103
VOTEPASS	-0.0006	-0.0139**	0.0020	-0.0015	-0.0072	-0.0170*	0.0030	0.0128	-0.0055	-0.0040
TEACHSTU	0.0029	0.0019	0.0027	0.0944	-0.0041	-0.0007	-0.0048	-0.0044	0.0007	0.0006
STAFFRAT	0.0043	-0.0000	-0.0044	0.0122	-0.0043	0.0130	0.0015	0.0028	0.0037	-0.0034
TAIDRAT	-0.0010	-0.0015	0.0015	-0.0031	0.0011	-0.0021	0.0006	-0.0040	0.0030	0.0035
MA_ORPHD	0.0047	0.0033	0.0076	0.0133	0.0066	0.0032	0.0125	0.0127	-0.0034	0.0242**
AVETASSN	0.0019	0.0060	0.0011	0.0017	0.0021	-0.0110	-0.0010	0.0094	0.0135	0.0122
MORE10YR	0.0043	0.0020	0.0015	0.0025	0.0105	0.0012	-0.0198*	0.0076	0.0060	-0.0070
BACHONLY	-0.0050	0.0035	-0.0037	-0.0050	0.0177*	0.0137	-0.0101	-0.0005	-0.0094	0.0107
NMTHSCI1	0.0176***	0.0030	0.0263***	0.0197*	0.0053	-0.0143	0.0060	0.0037	-0.0037	0.0097
NVOCED1	-0.0100*	0.0031	-0.0054	0.0076	-0.0150*	-0.0032	0.0094	-0.0004	-0.0032	-0.0153
NFAILS1	-0.0008	0.0030	-0.0055	-0.0226***	0.0015	0.0047	0.0077	0.0032	-0.0012	-0.0038
UPBOUND	-0.0046	-0.0034	-0.0027	-0.0052	-0.0028	-0.0056	0.0053	0.0076	-0.9167	-0.0256***
VOCEDSAC	0.0005	0.0005	0.0005	-0.0049	-0.0217***	-0.0165	0.0138	0.0034	-0.0031	-0.0038
GRADCOMP	0.0032	0.0000	0.0204***	0.0045	0.0062	0.0032	0.0001	0.0052	0.0029	-0.0001
ABL10%NB	0.0040	0.0006	0.0043	-0.0000	-0.0187**	-0.0026	-0.0113	0.0110	0.0000	-0.0009
AVEATEND	0.0064	-0.0011	-0.0006	0.0003	-0.0005	-0.0076	-0.0063	0.0118	0.0037	0.0220*
CLASTIME	-0.0005	-0.0004	-0.0040	-0.0231***	-0.0003	0.0069	0.0001	-0.0059	-0.0034	0.0118
MSNDEPRT	0.0011	-0.0027	-0.0097	-0.0254**	-0.0045	0.0055	0.0539***	0.0072	0.0070	-0.0007
PSCHPSM1	-0.0042	0.0001	0.0068	-0.0046	0.0104	0.0012	0.0079	-0.0073	0.0016	-0.0069
MSPHSCOL	0.0157*	-0.0015	0.0031	0.0078	-0.0055	0.0129	-0.0281*	-0.0097	-0.0058	0.0004
MSCHRATE	0.0000	0.0063	-0.0123	-0.0056	0.0272	0.0193	-0.0176	-0.0114	0.0010	0.0061

* $p \leq .01$.
** $p \leq .001$.
*** $p \leq .0001$.

Table 14--Continued

NOTE: Definition of variables:

REGPUB1 = regular public school
REGCATH1 = regular Catholic school
OTHPVT1 = other private school
STUBUSED = percentage of students bussed for racial balance
DESE6 = school under court order to desegregate (1=yes)
STUHISP = percentage of students Hispanic
STUBLACK = percentage of students black
NOENGHOM = percentage of students who do not speak English at home
MFAMINC = school mean of family income
CLREGCOL = percentage of class of 1979 attending 4-yr college
STUDROP = percentage of students who dropped out of school
PRO10GEN = percentage of sophomore class in the general track
PRO10VOC = percentage of sophomore class in the vocational track
AFOT = percentage of teachers who belong to AFT
NEA = percentage of teachers who belong to NEA
TASTRIKE = date of last teacher strike
NVOCFCL1 = number of vocational facilities
NACAFCL1 = number of academic facilities
VOTEPASS = whether last school levy passed (1=yes)
TEACHSTU = ratio of teachers to students
STAFFRAT = ratio of nonteaching staff to teachers
TAIDRT = ratio of teacher aides to teachers
MA_ORPHD = percentage of teachers with MA or PhD
AVETABSN = average number of days teachers absent
MORE10YR = percentage of teachers with > 10 yrs experience
BACHSALY = entry-level teachers' pay
NMTHSCI1 = number of math and science courses offered
NVOCED1 = number of voc ed courses offered
NFRILS1 = number of nonacademic/nonvocational courses
UPBOUND = school participates in Upward Bound? (1=yes)
VOCEDSAC = school participates in co-op ed? (1=yes)
GRADCOMP = competency test required to grad? (1=yes)
ABL10ENG = 10th-grade English ability grouping? (1=yes)
AVEATEND = ave percentage daily attendance
CLASTIME = number of class hours per year
MSMDEPRT = school mean deportment index
PSCHPBM1 = principal school problem index (hi=many problems)
MSPHSCQL = school mean sophomore school quality index
MSCHRATE = school mean student school rating index

1'2

BEST COPY AVAILABLE

TABLE 15

UNSTANDARDIZED REGRESSION COEFFICIENTS INDICATING EFFECTS OF SCHOOL CHARACTERISTICS ON TEN SPECIFIED OUTCOMES -- SIMULTANEOUS EQUATIONS

Dependent Variables

Independent Variable	Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deport-ment Index	Work Value	Self-esteem	Locus of Control
REGPUB1	-0.1317	-0.4065	0.2194	0.0777	-0.1633	0.1966	-0.1934	-0.0173	0.0202	0.0051
REGCATH1	0.2498	0.2065	0.2137	-0.4044	-0.0611	-0.3713	-0.2532	-0.0181	0.0052	-0.0076
OTHPVT1	0.4049	-0.2'05	0.0003	-0.0105	-0.1639	-2.0150	-0.0629	-0.1513***	-0.0327	0.0324
STUBUSED	-0.0140*	-0.0010	-0.0231**	-0.0000	0.0000	0.0060	-0.0093	0.0003	-0.0007	-0.0003
BESEBAE	0.0721	0.0901	-0.1047	0.0645	-0.0311	0.2056	-0.0565	-0.0064	-0.0025	-0.0007
SCHSIZE	-0.0001	-0.0001	-0.0001	-0.0002	0.0000	0.0001	0.0001	-0.0000	-0.0000	0.0000
STUHISP	0.0037	0.0107	-0.0008	0.0129	0.0001	0.0437	-0.0024	-0.0003	0.0001	0.0014*
STUBLACK	-0.0075**	-0.0014	-0.0084***	0.0033	0.0043***	0.0251*	0.0012	0.0006	0.0012**	0.0002
MOENGDOM	0.0005	-0.9002	-0.0022	0.0045	0.0029*	0.0153	-0.0019	0.0003	0.0006	-0.0011*
NFAMINC1	0.0144	0.0701***	-0.0328	0.0271	0.0148**	0.1905***	0.0003	0.0025	-0.0016	-0.0012
CLREGCOL	0.0070**	0.0032	0.0004	0.0092	0.0030**	0.0401***	-0.0005	0.0000	0.0006	0.0002
STUDROP	-0.0107*	-0.0200***	-0.0225***	-0.0222**	-0.0027	-0.0229	-0.0052	-0.0003	0.0004	0.0006
PRO10GEN	0.0022	0.0016	0.0018	0.0042	-9.0013	0.0107	-0.0005	-0.0004	0.0001	0.0002
PRO10VOC	0.0020	0.0001	0.0022	0.0002	-0.0026**	-0.0010	-0.0010	-0.0003	-0.0001	0.0003
AFDT	-0.2427*	0.0361	-0.0139	-0.0344	-0.0670	-0.7011	0.0077	-0.0049	0.0041	0.0221
NEA	0.0540	0.1547	0.2536*	0.1942	-0.0444	-0.1337	0.0729	0.0037	0.0163	0.0021
TASTRIKE	0.0960	0.0532	-0.1311	0.1786	0.0596	0.0624	0.0069	0.0177	-0.0065	0.0032
NVOCFCL1	-0.0961	-0.0051	-0.0052	-0.1157	-0.0101	-0.3124	-0.0012	0.0020	0.0054	-0.0052
NACAFCL1	-0.0010	-0.0031	-0.1501	-0.0122	0.0057	0.1950	-0.0512	0.0070	-0.0091	0.0095
VOTEPASS	-0.0'25	-0.3205**	0.0476	-0.0365	-0.0434	-0.9436*	0.0313	0.0216	-0.0099	-0.0066
TEACHSTU	0.1541	0.1043	0.1610	0.2596	-0.0602	-1.1726	-0.1250	-0.0181	0.0031	0.0345
STAFFRAT	0.0034	-0.0006	-0.0039	0.0106	-0.0009	0.0258	0.0006	0.0002	0.0002	-0.0002
TAIDRAT	-0.0173	-0.0279	0.0295	-0.0629	0.0053	-0.0957	0.0049	-0.0057	0.0045	0.0048
MA_ORPHD	0.0010	0.0013	0.0032	0.0056	0.0007	0.0031	0.0023	0.0004	-0.0001	0.0007**
AVETASSN	0.0055	0.0105	0.0036	0.0055	0.0017	-1.0015	-0.0014	0.0021	0.0032	0.0027
MORE10YR	0.0016	0.0000	0.0006	0.0010	0.0011	0.0012	-0.0036*	0.0002	0.0002	-0.0002
BACHBALY	-0.0000	0.0000	-0.0000	-0.0000	0.0000*	0.0002	-0.0000	-0.0000	-0.0000	0.0000
NMTHSCI1	0.1745***	0.0312	0.2835***	0.2177*	0.0145	-0.3500	0.0206	0.0020	-0.0030	0.0072
NVOCED1	-0.1413*	0.0423	-0.0791	0.1110	-0.0560*	-0.1049	0.0596	-0.0046	-0.0034	-0.0151
NFAILS1	-0.1072	0.0387	-0.0747	-0.3064***	0.0049	0.1457	0.0454	0.0007	-0.0012	-0.0035
UPBOUND	-0.0915	-0.0715	-0.0609	-0.1130	-0.0155	-0.2003	0.0511	0.0116	-0.0272	-0.0304***
VOCEDSAC	0.0404	0.1670	0.0100	-0.1016	-0.1117***	-0.7816	0.1249	0.0049	-0.0040	-0.0053
GRADCOMP	0.0640	0.0100	0.4572***	0.1007	0.0301	0.1525	0.0700	0.0001	0.0040	-0.0031
ABL10ENG	0.0749	0.0110	0.0094	-0.0010	-0.0930**	-0.1237	-0.1015	0.0169	0.0121	-0.0012
AVEATEND	0.0106	-0.0019	-0.0011	0.0154	-0.0039	-0.0319	-0.0051	0.0015	0.0005	0.0020*
CLASTIME	-0.0002	-0.0206	-0.0003	-0.0010***	-0.0000	0.0012	0.0000	-0.0000	-0.0000	0.0001
NONDEPRT	0.0096	-0.0254	-0.0971	-0.2545**	-0.0111	0.1253	0.2346***	0.0051	0.0051	-0.0005
PSCHPSN1	-0.0994	0.0000	0.1766	-0.1040	0.0671	0.0720	0.0093	-0.0132	0.0031	-0.0121
NSPHSCOL	0.6519*	-0.0647	0.1443	0.3601	-0.0627	1.3620	-0.5659*	-0.0314	-0.0199	0.0264
NSCHRATE	0.2652	0.2257	-0.4556	-0.2049	0.0651	1.6253	-0.2010	-0.0294	0.0020	0.0152

* p ≤ .01
** p ≤ .001
*** p ≤ .0001

Table 15--Continued

NOTE: Definition of variables:

REGPUB1 = regular public school
REGCATH1 = regular Catholic school
OTHPVT1 = other private school
STUBUSED = percentage of students bussed for racial balance
DESE6 = school under court order to desegregate (1=yes)
STUHISP = percentage of students Hispanic
STUBLACK = percentage of students black
NOENGHOM = percentage of students who do not speak English at home
MFAMINC = school mean of family income
CLREGCOL = percentage of class of 1979 attending 4-yr college
STUDROP = percentage of students who dropped out of school
PRO10GEN = percentage of sophomore class in the general track
PRO10VOC = percentage of sophomore class in the vocational track
AFOT = percentage of teachers who belong to AFT
NEA = percentage of teachers who belong to NEA
TASTRIKE = date of last teacher strike
NUUCFCL1 = number of vocational facilities
NACAFCL1 = number of academic facilities
VOTEPASS = whether last school levy passed (1=ye ,
TEACHSTU = ratio of teachers to students
STAFFRAT = ratio of nonteaching staff to teachers
TAIDRT = ratio of teacher aides to teachers
MA_DRPHD = percentage of teachers with MA or PhD
AVETABSN = average number of days teachers absent
MORE10YR = percentage of teachers with > 10 yrs experience
BACHSALY = entry-level teachers' pay
NMTHSCI1 = number of math and science courses offered
NVOCED1 = number of voc ed courses offered
NFRILS1 = number of nonacademic/nonvocational courses
UPBOUND = school participates in Upward Bound? (1=yes)
VOCEDSAC = school participates in co-op ed? (1=yes)
GRADCOMP = competency test required to grad? (1=yes)
ABL10ENG = 10th-grade English ability grouping? (1=yes)
AVEATEND = ave percentage daily attendance
CLASTIME = number of class hours per year
MSMDEPRT = school mean deportment index
PSCHPBM1 = principal school problem index (hi=many problems)
MSPHSCQL = school mean sophomore school quality index
MSCHRATE = school mean student school rating index

BEST COPY AVAILABLE

TABLE 16

EFFECTS OF ENDOGENOUS VARIABLES ON EACH OTHER

Independent Variables	Standardized Coefficients Dependent Variables: Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deportment Index
Verbal Test Score	0.5801***	0.1356***	0.2133***	0.3233***	0.0838***	0.0984***	0.0246
Math Test Score	0.0764***	0.5132***	0.0977***	0.0568***	0.0724***	-0.0046	-0.0239*
Science Test Score	0.0924***	0.0868***	0.4020***	0.1021***	0.0299***	-0.0039	0.0156
Civics Test Score	0.0511***	-0.0016	0.0139*	0.1473***	0.0196*	0.0239*	0.0019
Educational Exp.	0.0227***	0.0716***	0.0322***	0.0280***	0.3645***	0.0848***	-0.0303***
Occupational Exp.	0.0209***	-0.0041	-0.0051	0.0225***	0.0458***	0.2057***	-0.0118
School Deport. Vbl.	-0.0153***	-0.0161***	-0.0113	-0.0093	-0.0107	-0.0185*	0.3423***
Work Values	-0.0065	-0.0154***	-0.0017	0.0042	-0.0010	-0.0005	0.0266***
Self Concept	-0.0009*	-0.0056	0.0047	-0.0077	0.0132*	0.0058	-0.0153
Locus of control	0.0617***	0.0193***	0.0513***	0.0585***	0.0104	0.0262***	-0.0017
Average Grade	0.0449***	0.0912***	0.0244***	0.0497***	0.0893***	0.0330***	-0.0833***
Fathers College Exp.	-0.0092	0.0074	-0.0032	-0.0096	0.0518***	0.0196	0.0137
Mothers College Exp.	0.0144*	0.0129	-0.0028	0.0267**	0.0406***	0.0297**	-0.0013

Independent Variables	Standardized Coefficients Dependent Variables: Work Value	Self Esteem	Locue of Control	Average Graue	Father's Coll. Exp. For Youth	Mother's Coll. Exp. For Youth
Verbal Test Score	-0.0396**	0.0249	0.1768***	0.0967***	0.0381***	0.0545***
Math Test Score	-0.0274*	0.0104	-0.0152	0.0988***	0.0560***	0.0488***
Science Test Score	-0.0426***	0.0075	0.0701***	-0.0115	-0.0093	-0.0023
Civics Test Score	0.0209*	0.0086	0.0302***	0.0268***	0.0086	0.0149
Educational Exp.	0.0333***	0.0473***	0.0315***	0.0129	0.0793***	0.1011***
Occupational Exp.	-0.0045	0.0002	0.0236***	0.0119	0.0408***	0.0577***
School Deport. Vbl.	-0.0005	0.0181*	-0.0184*	0.0026	-0.0155*	-0.0086
Work Values	0.2881***	0.0272***	-0.0064	-0.0079	-0.0135*	-0.0041
Self Concept	0.0206*	0.3596***	0.0722***	0.0109	0.0028	0.0019
Locus of control	-0.0970	0.0560***	0.3210***	0.0165**	0.0161*	0.0203**
Average Grade	0.0168	0.0183	0.0146	0.5884***	0.0463***	0.0622***
Fathers College Exp.	0.0157	0.0115	-0.0135	-0.0137	0.3481***	0.0873***
Mothers College Exp.	0.0179	-0.0132	0.0184	-0.0058	0.0440***	.2726***

BEST COPY AVAILABLE

TABLE 16 (Continued)

Independent Variables	Unstandardized Coefficients Dependent Variables: Verbal Test Score	Math Test Score	Science Test Score	Civics Test Score	Educ. Expect.	Occ. Expect.	Deportment Index
Verbal Test Score	0.5845***	0.1439***	0.2390***	0.3622***	0.0231***	0.2510***	0.0110
Math Test Score	0.0739***	0.5231***	0.1051***	0.3612***	0.0192***	-0.0098	-0.0121*
Science Test Score	0.0823***	0.0815***	0.3983***	0.1012***	0.0073***	-0.0089	0.0067
Civics Test Score	0.0457***	-0.0015	0.0138*	0.1464***	0.0048*	0.0541*	0.0008
Educational Exp.	0.0709***	0.2629***	0.1246***	0.1084***	0.3485***	0.7479***	-0.0511***
Occupational Exp.	0.0084***	-0.0017	-0.0023	0.0100***	0.0050***	0.2085***	-0.0023
School Deport. Vbl.	-0.0376***	-0.0416***	-0.0310	-0.0255	-0.0072	-0.1149*	0.4067***
Work Values	-0.0829	-0.2077***	-0.0240	0.0602	-0.0034	-0.0171	0.1652***
Self Concept	-0.1113*	-0.0737	0.0647	-0.1072	0.0454*	0.1838	-0.0920
Locus of control	0.8389***	0.2766***	0.7763***	0.8850***	0.0387	0.9023***	-0.0110
Average Grade	0.5004***	1.0704***	0.3025***	0.6156***	0.2730***	0.9308***	-0.4485***
Fathers College Exp.	-0.1658	0.1394	-0.0648	-0.1909	0.2548***	1.0924	0.1109
Mothers College Exp.	0.2672*	0.2514	-0.0585	0.5507**	0.2068***	1.3974**	-0.0117

Independent Variables	Unstandardized Coefficients Dependent Variables: Work Value	Self-esteem	Locus of Control	Average Grade	Father's Coll. Exp. For Youth	Mother's Coll. Exp. For Youth
Verbal Test Score	-0.0031**	0.0021	0.0134***	0.0078***	0.0021***	0.0029***
Math Test Score	-0.0021*	0.0008	-0.0011	0.0077***	0.0030***	0.0025***
Science Test Score	-0.0029***	0.0005	0.0047***	-0.0008	-0.0003	-0.0001
Civics Test Score	0.0015*	0.0006	0.0020***	0.0019***	0.0004	0.0007
Educational Exp.	0.0390***	0.0121***	0.0083***	0.0036	0.0153***	0.0188***
Occupational Exp.	-0.0001	0.0000	0.0007***	0.0004	0.0009***	0.0012***
School Deport. Vbl.	0.0001	0.0036*	-0.0034*	0.0005	-0.0021*	-0.0011
Work Values	0.2863***	0.0285***	-0.0062	-0.0082	-0.0096*	-0.0028
Self Concept	0.0200*	0.3680***	0.0681***	0.0109	0.0020	0.0013
Locus of control	-0.0073	0.0623***	0.3293***	0.0180**	0.0121*	0.0148**
Average Grade	0.0145	0.0167	0.0123	0.5279***	0.0285***	0.0370***
Fathers College Exp.	0.0218	0.0169	-0.0182	-0.0197	0.3460***	0.0836***
Mothers College Exo.	0.0298	-0.0201	0.0257	-0.0075	0.0452***	0.2639***

school are rare, most analyses have not been able to test the assumption of one directional effects between parents and youth. Hotchkiss and Chiteji (1980), using longitudinal data, do report effects of youth on parents' expectations for the youth; their data describing parental attitudes were collected from the parents, however.

If it is true that the reason for strong cross-sectional correlations between youth's and parents' expectations is primarily due to effects of youth on their parents, then interpretation of the mechanisms by which parental status characteristics tend to be transmitted to their children must be reconsidered. To date it has been assumed that parental expectations of their children is one of the primary mechanisms. It seems likely that parental influence on youth is stronger when the youth are young, so that one possible reinterpretation is to allow the coefficients of effect to change over time. Without extensive longitudinal data, however, it would be difficult to test such a reinterpretation. It also may be useful to reconsider the importance of schooling mechanisms that influence both youth's and parents' career expectations of the youth. The roles of grades, tracking, and guidance counselors should be given intensive review.

What might be termed an "expansive world view" seems to form an important part of American cultural heritage. In this view, opportunity is "unlimited." It is important to take command of one's life, and the degree to which one believes in "taking charge" has an important bearing on what one can achieve. An opposing current in much of the sociology literature views people as being shaped in critically important ways by "structural" forces largely beyond their control or comprehension. Of course, such diffuse points of view cannot be rigorously tested with the data at hand. But the expansive world view that appears to predominate in American culture does suggest that the locus of control measure should have strong impact on test sores, grades, and career expectations. Whereas modest effects of locus of control on these outcomes are contained in table 16, the effects of test scores on locus of control tend to be higher than the reverse direction effects. This observation is particularly dramatic with respect to verbal test score. The standardized coefficient of locus of control on verbal test score is 0.0617 --certainly a reasonably large effect in a model containing so many variables. The effect of verbal test score on locus of control is nearly 3 times larger, however-- 0.1768. These observations suggest one mechanism by which young people destined to work in lower eschelon jobs after completing schooling are socialized to accept work in settings where they have little control over their own daily activities.

Summary and Conclusions

In this chapter, specific school characteristics are introduced as regressors to substitute for the school dummy variables used in the previous chapter. Forty school characteristics are included. Multiple partial correlations summarizing the combined impact of all 40 variables reveal that the measured school characteristics exercise substantial effects on the 10 outcomes. In every case, combined effects of the school characteristics are nearly as large as the (adjusted) effects of the school dummy variables.

These results are important for three reasons. First, they help to dispel notions that developed in response to the EEOR that schools are ineffective because between-school differences in verbal achievement was observed to be small after control for background. Second, they demonstrate that the study of differences between schools provides a useful basis for discovering characteristics of effective schools. Third, they help to identify specific school characteristics that account for effective schooling. Since the 40 school characteristics studied here do account for a sizeable portion of the reliable between-school differences in the 10 outcomes--net of socioeconomic background and the lagged dependent variable--we have evidence that important school characteristics have been included in the analyses.

The analysis of specific school characteristics that influence the 10 outcomes occurs in steps. In step 1, the 40 school characteristics are divided into 7 clusters: sector (private-public), desegregation, demographic composition, student context, teacher labor relations, policy instruments, and school quality ratings. Multiple partial correlations are calculated summarizing the combined effects of the variables in each cluster. It is concluded that 3 of the clusters exercise relatively strong effects on the 10 outcomes: demographic composition, student context, and the policy instruments. Since there are 20 variables contained in the cluster of policy instruments, these are further decomposed into 6 subclusters: resources and physical facilities, teacher and staff characteristics, curriculum, pedagogy, time in school, and deportment or school discipline. Two of these 6 clusters exercise notable effects on the 10 outcomes: curriculum and deportment. However, the deportment effects disappear when controls for endogenous variables are included.

The final step in the analysis examines effects of specific school characteristics as indicated by their associated regression coefficients. Of the demographic composition variables, it is found that school average family income increases the growth in test score performance and career expectations. Percentage of students who are black decreases test score change, but increases the two career expectation variables. The most important student context variables are the percentage of the previous year graduating seniors who attended college and the proportion of dropouts. The percentage of college-bound students raises test scores and career expectations; the percentage of dropouts depresses them. The percentage of 10th graders (in 1980) in the vocational track depresses educational expectations. Of the curriculum variables, the number of math and science courses offered increases growth in test score performance but does not influence the other outcomes. Offering work study in the school depresses both educational and occupational expectations.

All analyses include a control for the lagged dependent variable. This feature means that the results are equivalent to studying changes between the sophomore and senior years in high school. One set of analyses is carried out without controls for any lagged endogenous variables except that of the dependent variable in a given equation. A second set is executed with full control for lagged values of all the endogenous variables. The added controls do not alter the conclusions very much. The main result of controlling for the lagged endogenous variables is that most effects of school mean deportment are reduced to near zero. This reduction is due in large part to inclusion of individual-level deportment in the several equations.

Two noteworthy patterns emerge from the estimates of effects of the endogenous variables on each other. First, effects of youth's career expectations on the expectations that they perceive their parents to hold for them are larger than the effects of parents' expectations on youth. Second, test-score and career-expectation effects on locus of control are larger than the effects of locus of control on test scores and career expectations.

The major substantive findings of the chapter can be summarized as follows:

- Measured school characteristics account for a sizable part of the overall school differences in the 10 outcomes.

- School sector (private-public) does not exercise the strong effects on growth in academic achievement claimed for it by Coleman and his colleagues. Neither does sector influence most of the other outcomes (except work values--"other private" schools depress them).

- School desegregation does not have the strong depressive influence on education that many have feared, though it does have small depressive effects on verbal and science test scores.

- Demographic composition of students has relatively large and consistent effects on test scores and career expectations. Students from schools with high percentage of upper SES students (not black and high income) tend to perform better on tests than do other students. High average income raises career expectations, but so does high percentage of students who are black.

- Student context variables have relatively important effects on the 10 outcomes. The percentage of prior year seniors who attended college has positive effects on test scores and career expectations. The percentage of dropouts has opposite effects. The percentage of students in the vocational track depresses educational expectations.

- School resources and facilities generally do not have strong effects on the 10 outcomes. Neither does the ratio of teachers to students.

- Teacher and staff characteristics such as experience, training, and starting salary do not have strong effects on the 10 outcomes.

- The number of math and science courses offered at a school tends to improve academic growth. Work study in a school tends to decrease educational and occupational expectations of students in the school.

- Ability grouping and competency testing do not have much influence on the 10 outcomes.

- School aggregates of time spent in class do not influence the 10 outcomes.

The nature of the data used in these analyses must be recalled in interpreting the results, particularly with respect to effects of school resources and teacher characteristics. What has been found is that the particular resources and teacher characteristics used in the present analyses aggregated to the school level do not affect the 10 specific outcomes studied here. It has not been found that there are no resources and no teacher characteristics that affect student outcomes. It seems highly unlikely, for example, that students enrolled in a class in American history using a textbook with a 1955 copyright date and studing under a teacher who relies exclusively on the textbook would learn anything about the Vietnam War or Watergate. The appropriate interpretation of the findings here is that the effects of resources and teacher characteristics are more complex than can be captured in the present data with the models used here.

The most significant finding reported in this chapter is that student demographic characteristics and student context (e.g., percentage who attended college, percentage in vocational track) exercise strong effects on the 10 outcomes, especially on test scores and career expectations. It is not likely that demographic composition or student context directly affect these outcomes. Rather, they are proxies for intervening variables describing student culture, peer relations, and student attitudes. The results here suggest the need to carry out additional studies of student culture--for example, studies of the differences between athletic and academic orientation as in Adolescent Society (Coleman 1961).

Discovering that course requirements affect test scores is important because it suggests one fairly straightforward way in which educational policy can affect students. However, the findings raise additional interesting questions. Are the observed affects altogether due directly to increased exposure of students to academic subject matter or are there also intervening attitudinal and interpersonal mechanisms at work. It is certainly plausible, for example, that requiring many academic courses of all students "sends a message" that such material is important. It may also stimulate students to discuss such material more frequently than would otherwise be the case.

CHAPTER 6

EFFECTS OF DROPPING OUT OF HIGH SCHOOL

The inference that schooling is ineffective because small between-school differences in verbal achievement were observed in the EEOR data after controlling for status background is clearly in error. If all schools were doing an equally effective job, no matter at what level of effectiveness, between-school differences would not appear. This point has been made repeatedly in the literature (Alexander, McPartland, and Cook 1981; Armor 1972; Gilbert and Mosteller 1972; Heyns 1978; Madaus, Airasian, and Kellaghan 1981; Murnane 1975; Rutter et al. 1979; Wiley 1976). It has been argued that little mathematics and writing skill would develop in the absence of any schooling. Generalizing this point, it has been argued that the amount of time spent in school should have a strong impact on how much is learned.

Wiley makes this point and presents empirical findings showing the impact of the amount of class time per year on the amount learned (Wiley 1976; Wiley and Harnischfeger 1974). Karweit (1976) extends Wiley's analysis; she concludes that effects estimated by Wiley are too large but that the amount of exposure to schooling does have a positive effect on the amount learned. Heyns (1978) shows generally positive effects of attending summer school, but the effects are larger for high SES-youth. Murnane (1975) displays graphs that show a decline or leveling off in the learning of elementary students during summer months. Gray, Smith, and Rutter (1980) conclude that truancy has a negative effect on school performance. Their results are based on a British sample that includes a statistical control for I.Q. The chapter on school effects in this report, however, fails to show any effects of the amount of class time per year (aggregated to the school level) or of average daily attendance.

Two of the chief difficulties in evaluating the effects of the length of time exposed to schooling on achievement are that (1) the variation in the length of the school year (in days) and amount of time spent in class per day tend to be restricted and that (2) the effects of time of exposure probably level off at some value below the average length of the time spent in school in American high schools. Thus, the slope of learning on class time is most likely quite flat over the range of most available data. This second problem is similar to the difficulty of evaluating effects of class size.

Both of the major difficulties just alluded to may be circumvented by studying the effects of dropping out of school on the development of basic skills. To do this, one must have test scores for dropouts before and after they have left school and for nondropouts at the same time points. One important advantage of the HSB data is that they do contain these types of information.

One of the chief obstacles to valid inferences regarding the effects of dropping out of school on learning is that low achievers tend to be self-selected into leaving school before graduation. Control for test scores prior to dropping out while studying effects on test scores after dropping out helps to reduce threats to inference due to this selectivity bias. Inclusion of background controls also helps to reduce such threats.

This chapter presents a preliminary study of the effects of dropping out of high school on growth/decline in verbal test score and mathematics test score. A standard linear model is evaluated first, then an interaction model based on the Sorensen-Hallinan (1975) theoretical presentation is studied. Because interaction models use up many degrees of freedom and often are difficult to estimate due to collinearity among the product terms, a restricted set of background controls is used. This set includes race, gender, a socioeconomic index, and log of family income. The socioeconomic index includes both parent's occupational status (Duncan SEI for broad occupational categories), both parent's educational achievement, and an index of possessions in the home (described previously). Each component of the index was standardized to zero mean and the unit variance prior to calculating the index value. The SES index is the mean of its standardized components.

Estimates of the coefficients for the linear model of dropping out of school before graduating are displayed in table 17. The effects of dropping out in the linear specification are highly significant statistically and of modest size. Dropouts average about 1.8 points lower on the standardized verbal test score at first follow-up than do nondropouts. The analogous figure for mathematics is about two points. Recall that the standard deviations on these test scores are just under 10. Since the base year test scores are included in these models, the dropout coefficients also indicate differential growth (decline) in the 2 test scores over a 2-year interval. While the dropout effects are not negligible, neither are they as strong as one might expect. Comparing the standardized coefficients across independent variables shows that the combined effects of the background controls are substantially larger than effects of dropping out.* The effects of dropping out are, however, greater than the effects of race in both equations.

Since one of the primary goals of schooling is to impart academic knowledge indicated by verbal and math test scores, and since exposure to English grammar, writing and vocabulary, and mathematics operations is considerably more intensive and systematic in school than out of school, one might expect a priori that dropping out of school would have a stronger effect on indicators of learning than the estimates produced here suggest. There are, of course, many potential threats to the accuracy of these estimates, including measurement error, differential timing of the dropout decision among students,

*Use of standardized coefficients with the dropout variable should be done cautiously, since its standard deviation is relatively low and it may be relatively volatile in response to school policies. The ratio of the maximum possible standard deviation of the dropout variable to its observed value is 1.75. Multiplying this ratio by the standardized regression coefficient for dropout gives a rough estimate of the maximum value of the standardized coefficient or -.094 for verbal test score and -.100 for math test score.

TABLE 17

LINEAR EFFECTS OF DROPPING OUT OF HIGH SCHOOL
ON VERBAL AND MATH TEST SCORES

	Dependent Variable			
	Verbal test score		Math test score	
Independent Variable	Unstd. Coefficient	Standardized Coefficient	Unstd. Coefficient	Standardized Coefficient
Intercept	9.934	--	9.977	--
Lagged dependent variable	.851	.804	.816	.738
Race	-1.087	-.039	-1.059	-.035
Gender	.394	.021	-.640	-.031
Socioeconomic index	.814	.061	1.332	.092
Log of family income	.444	.027	.632	.035
Dropout (yes=1)	-1.777	-.054	-2.023	-.057
R-square	.7474		.6587	

NOTE. All coefficients significant at $p \leq .0001$.

omission of adequate controls from the models, and specification error more generally. The remainder of this chapter presents exploratory analyses of the possible consequences of specification error.

A priori, it seems a good hypothesis that learning requires "readiness" and exposure to new information--or review of old information that has been forgotten or learned imperfectly--(Sorensen and Hallinan 1977; McPartland and Karweit 1979; Walberg 1981). One cannot learn material to which one has not been exposed, and one cannot learn material that is, in some sense, too difficult. That is, it takes both exposure and readiness for learning to occur.

If schooling has any effects that are claimed for it, then dropping out of school or remaining to graduate must be a strong indicator of exposure to information reflected by verbal and math test scores. The linear specification of the effects of dropping out, however, does not express the hypothesis that both exposure and readiness are needed for learning to occur. On the contrary, the linear specification implies that exposure and readiness are perfect substitutes. The hypothesis that both exposure and readiness are required is better expressed by an interaction specification. Sorensen and Hallinan (1977) propose a very general specification of the interaction hypothesis:

learning = f[(readiness) x (exposure)],

where learning stands for the rate of learning with respect to time, and f initially is an unspecified function. For expository purposes, it is useful to set f to a constant and denote it by the letter h:

(1) learning = h(readiness) x (exposure)

In this formulation it is readily apparent that the effect of readiness on learning depends on the rate of exposure--

(2a) effect of readiness = h(exposure)

and that the effect of exposure depends on the degree of readiness--

(2b) effect of exposure = h(readiness).

This simple model conforms to the intuitive idea of no exposure, no learning irrespective of readiness and no readiness, no learning irrespective of exposure.

Although the above formulation is useful as a starting point, it is too simplistic for empirical investigation. Two matters must be attended to--specification of a usable functional form and identification of empirical indicators of exposure and of readiness.

In the present context of investigating the effects of dropping out of school on learning, exposure is indicated by whether or not one drops out of school. Exposure is postulated to be substantially higher among school stayers than among school leavers. Readiness is indexed by five variables--the current value of the dependent variable, race, gender, socioeconomic background, and (log) family income. Sorensen and Hallinan (1977) include a vector of socioeconomic background variables and IQ, so the operational definitions used here follow closely precedent found in the literature.

Now, let readiness be viewed as a linear function of its five indicators--

(3a) readiness = $p_0 + p_1 \cdot$race $+ \ldots + p_4$(log fam. inc.) $+ p_5$(current test score),

and let exposure be a linear function of dropping out of school--

(3b) exposure = $q_0 + q_1 \cdot$dropout.

The linear forms are proposed primarily for simplicity. Since scaling of readiness and exposure cannot be defined a priori, the constants in these linear functions serve as scaling constants. Change in knowledge (y) is defined both by learning and forgetting; it is, in fact, the difference between learning and forgetting:

$$\frac{dy}{dt} = \text{learning} - \text{forgetting}$$

For the present analyses, the forgetting function is defined simply as a constant proportion of current knowledge:

forgetting = ky $\quad k>0$

Inserting these definitions back into the original (linear) version of the model and denoting learning as the derivative of knowledge with respect to time (dy/dt) gives a differential equation of the following form:

$$(4) \quad \frac{dy}{dt} = a_0 + a_1 d + b_1 x_1 + \ldots + b_4 x_4 + b_5 y + c_1 x_1 d + \ldots + c_4 x_4 d + c_5 x_5 yd,$$

where

y = test score (verbal or math),
x_1 = race (black = 1),
x_2 = gender (female = 1),
x_3 = socioeconomic background index,
x_4 = log of family income,
d = dropout (1 = yes), and
a_j, b_j, c_j = constants.

The constants here (a_j, b_j, and c_j) are straightforward combinations of h, the p_j, q_j, and k.

Under the assumptions that the x_j are constant and school dropouts leave school immediately following completion of the base year survey and do not re-enter school, integration of this differential equation leads to a form that may be estimated with the first two waves of the HSB data:

$$(5) \quad y_2 = a_0^* + a_1^* d + b_1^* x_1 + \ldots + b_4^* x_4 + b_5^* y_1 + c_1^* x_1 d + \ldots + c_4^* x_4 d + c_5^* yd,$$

where y_2, y_1 are first follow-up and base year test scores, respectively, and the a_j^*, b_j^*, and c_j^* are constants (over observations but not over time) that are related to the coefficients in the differential equation as defined previously. Upon adding a disturbance to this result, a fairly standard interaction specification occurs that can be estimated by regression methods (OLS is used in the present case).

Since d = (0,1), separate regression equations for nondropouts and dropouts are implied:

$$y_2 = a_0^* + b_1^* x_1 + \ldots + b_4^* x_4 + b_5^* y \qquad \Big| \quad d = 0$$

$$y_1 + (a_0^* + a_1^*) + (b_1^* + c_1^*)x_1 + \ldots + (b_4^* + c_4^*)x_4 + (b_5^* + c_5^*)y_1 \qquad \Big| \quad d = 1$$

Estimates of the coefficients for these two regressions are displayed in table 18. The F values for both verbal and math test scores show highly significant effects due to the interaction hypothesis.* Thus, we can be relatively secure that the linear form is a misspecification and that some interaction between dropping out of school (exposure) and the indicators of readiness does in fact occur. By far the most important such interaction occurs between dropout and the lagged test score. This observation holds for both verbal and math test scores. In fact, for the mathematics equation, the only significant difference (at $p \leq .01$) between slopes for school stayers and school leavers is on the lagged math test score. The difference between slopes on race is nearly significant, however ($p \leq .0139$). In the equation for verbal test score, the differences between coefficients on both race and gender are statistically significant, though not with the low probability level associated with the difference between the coefficients on lagged test score.

The underlying idea motivating these regressions is that effects of exposure on learning are facilitated by readiness and vice versa. This hypothesis does predict statistical interactions of the general form just presented, but the mere presence of such interaction certainly does not confirm the hypothesis beyond reasonable doubt. The data do contain additional information that is pertinent to evaluating the assumptions that were imposed in order to translate the generic hypothesis (eq. 2) into testable form; namely, the coefficients p_j connecting achievement and the exogenous variables to "learning readiness" can be estimated (to a constant of proportionality) from the regression coefficients given in table 18. The formula for these estimates is

$$(6) \quad c_j = \left(\frac{b_5 + c_5}{b_5^* + c_5^* - 1}\right) c_j^* + \left[\left(\frac{b_5 + c_5}{b_5^* + c_5^* - 1}\right) - \left(\frac{b_5}{b_5^* - 1}\right)\right] b_j^* \qquad \Big| \quad j < 5 \ ,$$

(6a) $c_5 = (\ln(b_5$ [illegible]$) - \ln b_5^*)/t$

*These tests were conducted by the standard method of adding product terms to the linear specification and conducting an F test of significance of the increment to R-square.

TABLE 18

INTERACTION EFFECTS OF DROPPING OUT OF HIGH SCHOOL
ON VERBAL AND MATH TEST SCORES

	Dependent Variable			
	Verbal test score		Math test score	
Independent Variable	Non-dropouts	Dropouts	Non-dropouts	Dropouts
Intercept	9.422(***)	14.110	9.202(***)	21.481
Lagged dependent variable	.861(***)	.730	.832(***)	.509
Race	-.999(*)	-1.898	-.963	-1.883
Gender	.469(**)	-.306	-.672	-.302
Socioeconomic index	.769	1.130	1.325	.985
Log of family income	.439	.489	.623	.774
F-ratio testing for interaction	19.212		52.985	
Probability of no interaction	$p \leq .0001$		$p \leq .0001$	

* prob. of diff. between nondropouts and dropouts $\leq$ .01.
** prob. of diff. between nondropouts and dropouts $\leq$ .001.
*** prob. of diff. between nondropouts and dropouts $\leq$ .0001.

NOTE. 1. All coefficients are unstandardized OLS regression coefficients.

2. All "main" effects significant at $p \leq .0001$.

where b_j^* and c_j^* are regression coefficients (equation 5), and b_5 and c_5 are coefficients in the differential equation (equation 4) and can be estimated from the regression coefficients as follows:

$$b_5 = (\ln b_5^*)/t,$$

$$b_5+c_5 = [\ln(b_5^* + c_5^*)]/t.$$

On setting h = 1, and $q_1 = -1$ (dropping out reduces exposure), $p_j = -c_j$.

It is clear from equation (6) and the relation $p_j = -c_j$ that the differences between coefficients in the nondropout and dropout equations (c_j^*) give a rough indication of the effects of the corresponding variables on learning readiness. Generally, negative values of c_j indicate positive effects on readiness. Given the form of the model, however, the c_j^* are not good indicators of these effects; the c_j provide better estimates.

Table 19 contains estimates of p_j and displays the values of c_j^* for comparison. It also contains standardized estimates of the p_j to facilitate comparison between variables.* As inferred from equation (6), the differences between regression coefficients in the nondropout and dropout equations (c_j^*) do show a rough approximation to the estimates of effects on learning readiness, though the sign is reversed and the scale magnified. Since statistical tests have not been calculated for the p_j, this correspondence is important. Although statistical significance of the c_j cannot be interpreted strictly as indicating the statistical significance of the p_j, significance of the c_j must be taken as an indication of the significance of the p_j pending calculation of significance tests for the p_j.**

Past empirical research has shown consistent positive effects of socioeconomic background and family income on achievement test scores--both verbal and quantitative. Survey data also show consistent negative effects of being black. Effects of being female have been positive on verbal achievement and negative on math achievement. Since these findings have been repeated many times, one might expect them to be reflected in the p_j displayed in table 19. An even stronger a priori hypothesis is that current achievement is an important indicator of readiness.

The data lend unmistakable support for the hypothesis that the effect of current achievement on readiness is positive. The expected pattern of the other coefficients is not present, however. The estimated effects of socioeconomic background and family income are small and in three out of four cases the signs of the coefficients are negative rather than positive, as expected.

---

*Standardized coefficients were calculated by multiplying the unstandardized coefficients by the standard deviation of the corresponding independent variable and dividing by the standard deviation of the lagged test score.

**Appropriate methods are available and the intention is to carry out the calculations in the future (see Rao 1973).

TABLE 19

ESTIMATES OF EFFECTS OF EXOGENOUS VARIABLES AND ACHIEVEMENT ON "LEARNING READINESS"

	Dependent Variable = Verbal Test Score		
		Unstandardized	Standardized
Indicators of Readiness	$\hat{c}_j^*$	$\hat{p}_j$	$\hat{p}_j$
Current level of verbal achievement	-.130***	.082	.086
Race (1=Black)	-.899*	.568	.022
Gender (1-female)	-.775**	.431	.024
Socioeconomic background	.362	-.245	-.020
Log of family income	.050	-.049	-.003

	Dependent Variable = Math Test Score		
		Unstandardized	Standardized
Indicators of Readiness	$\hat{c}_j^*$	$\hat{p}_j$	$\hat{p}_j$
Current level of math achievement	-.323***	.246	.272
Race (1=Black)	-.921	.768	.028
Gender (1-female)	.370	-.160	-.009
Socioeconomic background	-.340	.047	.004
Log of family income	.151	-.191	-.012

* $p \leq .01$.
** $p \leq .001$.
*** $p \leq .0001$.

NOTE. No statistical tests were calculated for the $\hat{p}_j$.

The associated c_j^* are not significant statistically. The effect of being female on readiness for verbal learning is fairly large and positive, as expected. The effect on math readiness is negative, as expected, but the magnitude is near zero.

Although the positive effect of being black on learning readiness (verbal and math) was not predicted, its presence is intriguing. It suggests that, other things being equal--including current achievement level--blacks are more amenable to learning than are whites. It must be noted, however, that dropping out of high school does not necessarily imply no exposure to experiences that facilitate recall or learning of material measured by the HSB tests. It is likely that black dropouts enter an environment with less exposure to such experiences than do nonblacks. Further investigation of these possibilities is merited.

From a purely statistical standpoint, the interactions involving race, gender, SES, and income could be dropped from the math equation, and they make only a marginal contribution to the equation for verbal test score. In fact, the Sorensen-Hallinan (1977) model does not predict these interactions; it predicts interactions only on the lagged test score. Hence, the HSB data tend to support the Hallinan-Sorensen formulation.

There are, however, some important difficulties with the Hallinan-Sorensen theory. First, it does not allow for forgetting. It not only fails to build in an explicit forgetting function, the basic equation (their equation 1) does not permit any information to be forgotten. Second, their model does not identify current level of knowledge as an aspect of learning readiness. Thus, their model excludes the possibility that readiness itself is learned--an exclusion for which Hauser (1978) has strongly criticized Sorensen and Hallinan. Third, the theory is predicated on a model that identifies exposure to new knowledge with a simplified process over time--new information is a constant proportion of that part of a syllabus not yet presented. This model has the effect of identifying opportunity for learning with the b coefficient in the following differential equation: $dy/dt = a + by + cx$. Again, Hauser (1978) is critical; opportunity for learning is not by definition equivalent to stability of knowledge, he agrues. In spite of these difficulties with the Sorensen-Hallinan theory, it is an important first step toward applying a realistic structural model to the study of the effects of schooling on learning.

The importance of the interaction model on learning can be guaged by comparing the accumulated effects of dropping out of school predicted by the linear specification to those predicted by the interaction specification. Table 20 displays these estimates. Effect estimates for the interaction model are shown separately by race and gender subgroups; only one estimate for each dependent variable is given for the linear model, since these estimates are the same irrespective of subgroup. The interaction model predicts substantially larger effects of dropping out in every comparison except for verbal achievement of white males. Effects of dropping out are uniformly higher for mathematics achievement than for verbal achievement, irrespective of whether the linear or interaction estimates are taken. Moreover, the discrepancies between the linear and interaction model are noticably higher for math test scores than for verbal test scores. In fact, the effects of dropping out or

TABLE 20

EFFECTS OF DROPPING OUT OF SCHOOL ON
VERBAL AND MATH TEST SCORES BASED ON
AN INTERACTION AND A LINEAR SPECIFICATION

Dependent Variable	Interaction Estimates for Race and Gender				
	Black Females	White Females	Black Males	White Males	Linear Estimate
Verbal test score	-3.363	-2.463	-2.588	-1.689	-1.777
Math test score	-4.012	-3.092	-4.382	-3.462	-2.023

math achievement is quite dramatic if the interaction estimates are taken. In all four race and gender subgroups, these effects are larger than one-third of a standard deviation.

It also is noteworthy that the achievement of blacks is threatened more by dropping out of school than is the case for whites. This pattern holds for both verbal and math achievement, irrespective of gender. Both black females and black males fare worse for dropping out of school than do whites of either gender. With the present data, it is only possible to speculate on the reasons why the effects of dropping out of school are stronger on blacks than on whites. The formal model justifying the interaction specification intrepets race as an indicator of readiness. The results here suggest that, ceteris paribus, blacks are more ready to learn than whites. Alternatively, as noted previously, the results of this paper could be interpreted to mean that black dropouts experience less exposure than white dropouts; this may be due to the home and work environments they enter.

Evaluation of the Interaction Model and Next Steps

The interaction model produces a clearly superior fit to the data as compared to the linear model. Further, it is based on a general view of the learning process that is more in line with informal observation and reasoning than is the linear model. Consequently, there need be little hesitation in preferring the interaction model.

Although the interaction model represents an important improvement over the linear model, it can only be viewed as a rough approximation of the process under study. First, predicted interaction between dropout and exogenous variables are not well supported in the data. Second, exposure to material measured by the achievement test must be quite heterogenous within school stayers and school leavers. Dropping out therefore is a highly imperfect measure of exposure. Third, the five indicators of learning readiness used here--current test score, race, gender, SES, and income--undoubtedly do not capture all the variation in readiness. For example, they do not include good indicators of motivation, time needed to learn, and time one is willing to spend on learning.

Future work on the exposure and dropout issue should take steps to improve the indicator of exposure. Measures of school coursework taken and time on homework could be used to supplement dropout as indicators of exposure. Indexes of readiness should also be expanded. Natural candidates to be used as additional indicators include (1) an expanded set of exogenous variables; (2) attitudes toward school such as liking school, satisfaction with school, and judgment of the importance of schooling; and (3) educational expectations.

Specification of the forgetting function deserves more attention than it received here. In fact, the rate of forgetting probably is not constant across persons, as postulated here. It more likely depends on some of the same factors that determine readiness and on the amount of exposure to review material. It may also depend on cognitive style learning and the depth of knowledge.

In principal, expanding the indicators of exposure and readiness is straightforward, but in practice it is cumbersome. Incorporating new variables into an interaction model expands the number of terms in the equation much more rapidly than is the case for a linear model. The expansion of terms in the interaction equation could be reduced by nonlinear estimation, but such procedures are not routine, especially with missing data, and are likely to be expensive with large samples. Further, the resulting product variables generally are highly colinear thus rendering calculating algorithms inaccurate. Although colinearity can be reduced substantially by adjusting the elements of the product terms, the adjustments add complexity to the work.*

Difficulties of expanding the interaction model ought not to deter work on it, however. Evidence presented here combined with the appeal of viewing learning as a product of both readiness and exposure suggests that the effort may pay handsome dividends.

Summary and Conclusions

This chapter presents analyses of the effects of dropping out of school on verbal and mathematics achievement. Initially, a linear specification of the effects of dropping out is tested. It is found that dropping out produces declines in both verbal and math achievement, as one might expect. These effect estimates are highly significant statistically but they are of moderate magnitude.

The linear model is replaced by an interaction model based on a general theory of how learning is the product of "readiness" and exposure. Readiness

*In the present analyses, the mean of each indicator of readiness was subtracted from its value before taking the product with dropout. This procedure eliminated the colinearity problem, but adjustment of the resulting coefficients to represent the original model is cumbersome.

is indexed by current level of achievement, socioeconomic background, and personal characteristics (race and gender). The interaction model produces substanially larger estimates of the negative consequences of dropping out of school than does the linear model--especially on math achievement. It also is found that dropping out produces more serious decline in test scores of blacks than of whites. Although the predictions of the interaction model are not born out in every detail, it is concluded that the combination of empirical evidence and theoretical superiority of the model over a linear specification are more than adequate to merit further study of the interaction model.

In brief, four important conclusions are implied by this study:

- Schooling is effective in transmitting general verbal and math skills that are not necessarily explicit parts of course syllabi. Otherwise, school dropouts would learn as much (forget as little) as school stayers.
- Dropping out of school has strong negative impact on basic skills. To the extent that literacy and calculating skills are desirable for individuals and society, youth ought to be counseled to stay in school.
- Dropping out has particularly strong negative influence on the basic skills of black youth. Intensive efforts to keep black youth in school appear justified.
- Statistical analyses based on the general view that the product of "learning readiness" and exposure to subject content produce learning deserve further investigation. The empirical results of the product model are much superior to those of the linear model, and the theory associated with the product model is more satisfying.

CHAPTER 7

EFFECTS OF CURRICULUM AND COURSE WORK ON COGNITIVE AND NONCOGNITIVE OUTCOMES

Review of Past Research

Perhaps in part due to increasing availability of longitudinal data, interest in the effects of curriculum on post-high school educational and labor market outcomes has quickened in the past few years. One style of analysis has been to confine attention to subsamples of respondents who do not pursue education beyond high school and to investigate effects of a vocational curriculum on labor market outcomes such as wage, earnings, and unemployment. There are two important difficulties with this type of analysis. First, it is difficult to control statistically for selectivity bias associated with self-selection of sample members into groups that do and do not pursue schooling after high school. Second, information on labor market experience following high school does not extend over a long enough time period to permit adequate evaluation of the full impact of vocational curriculum. Nevertheless, some important tentative findings have emerged from this line of investigation.

One of the most important findings of this research is that self-reported membership in curriculum tracks such as academic, vocational, and general does not form an adequate basis for studying the impact of vocational curricula on labor market outcomes. First, the correlation between self-report measures of curriculum track and number and sequencing of courses is not high (Campbell, Orth, and Seitz 1981; Meyer 1981a; Rosenbaum 1980). Second, the impact of secondary vocational education on post-high school labor market outcomes depends on the specific vocational course work that one pursues. The most consistent and strongest effects occur for females who take business and office course work (Meyer 1981b). Some advantage in labor market outcomes apparently accrues to males who take trade and industrial courses (Meyer 1981b).

The composite picture suggested by these findings is that persons taking vocational curricula are too heterogeneous to be adequately characterized by vocational and nonvocational or academic and nonacademic. This conclusion applies whether one takes self-reported measures of curriculum track (e.g., Alexander and McDill 1976) or a number or proportion of courses classified as vocational (e.g., Rumberger and Daymont 1982).

Studies of the influence of vocational education on labor market outcomes tend to be motivated, either implicitly or explicitly, by a human capital perspective and supply and demand theory. Meyer (1981b), for example, studied the effects of vocational education on present discounted value of an earnings stream over an 8-year time span. He predicts and observes declining effects of vocational curricula as the length of time out of school increases. Finally, he takes a theoretical position that supply and demand will, in the long run, equalize wages and earnings of vocational and nonvocational students.

A second line of inquiry takes a somewhat different perspective than the theory of human capital and market forces just described. First, a broader array of outcomes of high school curriculum are studied, including cognitive and attitudinal outcomes in high school, number of years of schooling completed, and occupational status, as well as income and earnings outcomes. Examples of this line of work include Alexander and McDill (1976), Alexander, Cook, and McDill (1978), Heyns (1974), Oakes (1982), Rehberg and Rosenthal (1978), and Rosenbaum (1976; 1980). Generally, this work has been carried out within a framework roughly corresponding to the status attainment paradigm. An important idea in this type of study is that one of the mechanisms by which socioeconomic background is transmitted between generations is assignment to curriculum track in high school. Low-SES youth are assigned to nonacademic tracks, and this observation cannot be accounted for by ability differences between SES levels. Curriculum track in turn affects cognitive development, the nature of the peers with whom one associates, career plans, and other attitudes (Alexander and McDill 1976).

Rosenbaum (1976) argues that a track system in schools mirrors the larger social system in microcosm, that the influence of tracking is subtle and profound, and that it shapes the IQ of students in ways that tend to perpetuate the tracking system. He argues that a rigid stratification system exists in high schools, based on tracking. The system is analogous to a tournment; one may fail at any point by being placed in a nonacademic curriculum track. Once having fallen out of the academic track, it is virtually impossible to reenter it. Rosenbaum presents impressive evidence of the veracity of this point for one high school in Boston that he studied extensively. Being relegated to a nonacademic track led to discrimination in at least three forms; (1) repeated teacher insults, (2) diluted curriculum, and (3) application of a weighting system in computing class rank that was extremely biased against students in a nonacademic track. Since colleges (at the time of the study) placed heavy weight on class rank, this procedure had important consequences.

The recent Carnegy Foundation report (Boyer 1982) provides independent, though antecdotal, evidence that nonacademic students are short changed. The report summarizes as follows:

> . . . vocational students are often academically short-changed. This is, in fact, the most serious issue presented by the current tracking pattern. (p. 123)

The report cites as evidence of this conclusion numerous comments of teachers heard during field observations associated with the report. The evidence is antecdotal, but nevertheless sobering. A principal in one of the 15 schools visited is quoted as follows:

> The initial assignment is critical and it occurs in elementary school. It completely determines what the student will come away with. Some students come into school, get lost in a nonacademic life--do nothing, learn nothing, just hang around for four years. (p. 125)

Oakes (1982) comes to similar conclusions. She finds that teachers offer nonacademic track students a watered down curriculum that focuses on rudimentary basic skills rather than analytic skills, expect lower performance and less homework from nonacademic track students, emphasize conformity for nonacademic studies at the expense of problem solving, are less enthusiastic and not as clear in class presentations in nonacademic classes, are more punitively oriented toward nonacademic students, and spend less time in nonacademic classes on instruction. Further, she finds that nonacademic class students feel less respected by their peers and view peer relationships as more conflictual than do academic tract students. Her conclusions are compromised, however, by lack of controls for measures of ability, achievement, and socioeconomic background.

Papers by Alexander and his collaborators also have supported the importance of curriculum track in shaping outcomes such as grades in school (class rank), math test scores, characteristics of one's peers, and educational expectation (Alexander and McDill 1976). In a more recent publication based on longitudinal data, Alexander, Cook, and McDill (1978) support their original conclusions regarding effects of curriculum track on standardized achievement test score, educational expectation, and expectations held by significant others for youth. In each case, lagged values of the dependent variables were entered as control variables, thus helping to confirm the effects of curriculum.

In contrast, after extensive statistical analysis, Rehberg and Rosenthal (1978) conclude that the independent effects of curriculum track in their upstate New York sample are modest and serve more as a mechanism for translating "merit" into achievement than for transmitting status between generations. Jencks and his associates (1972); Heyns (1974); and Hauser, Sewell, and Alwin (1976) agree with Rehberg and Rosenthal (1978)--curriculum is not a critical variable in determining outcomes related to status attainment.

Most studies in the status attainment tradition have relied on self-report of curriculum and have dichotomized the track variable into college and noncollege preparatory. Rosenbaum (1980) shows that student perceptions of curriculum track often do not correspond to official records on student transcripts. Track as defined by official records has a stronger effect on educational plans and college attendance than does perceived track. Perceived track plays a role as a mediator between "objective" track and college plans but has no important role in determining college attendance, once objective track is controlled.

The question of the direction of the effect among variables such as educational and occupational expectations, academic achievement (or ability), and curriculum track merits further study. Rehberg and Rosenthal (1978), for example, propose far-reaching conclusions about the relative influence of ability or "merit" and status origin on college plans and college entry; their analyses are based on the untested assumption that "ability" affects track, and track does not affect ability. Heyns (1974), using cross-sectional data, also assumes that the direction of effect is from "ability" to track placement. On the other hand, Alexander and McDill (1976) assume that curriculum track affects math achievement test scores, and Rosenbaum (1975) produces evidence in longitudinal data implying that IQ is affected by track placement. Clearly, some further clarification of this issue is in order.

If students in nonacademic tracks are subjected to indignities by teachers, curriculum track should depress attitudes such as self-esteem and locus of control. This result would certainly be predicted from symbolic interaction theory that indicates that a person's self-concept and other attitudes are developed through interpersonal interactions. On the latter point, Rehberg and Rosenthal (1978) summarize speculation regarding the potentially strong negative effects of being placed in a noncollege track and its attendant "failures" on self-esteem. They note that when failure is based on "merit," as their analysis suggests, its psychological acceptance probably is more difficult than it would be if the failure could be blamed on an unfair stratification system. A similar line of reasoning suggests that school behavior or deportment might be negatively affected by placement in a non-academic track--those with low self-esteem and sense of external control of their fates may act out their frustrations by "misbehaving" in school. There is some ambiguity about whether placement in an academic or vocational track affects work values, and if so, in what direction. On balance, it seems likely that both academic and vocational tracks raise commitment to work values. However, it is possible that the hypothesized frustration associated with being in a nonacademic track leads to a decline in work values.

The present paper examines effects of both curriculum track and course work on the same 10 outcome variables studied in previous chapters--verbal test score, math test score, science test score, civics test score, educational expectation, occupational expectation, self esteem, locus of control, work values, and school deportment. The outcomes are closely associated with outcomes studied in the status attainment work on effects of curriculum track. But by including both track membership and course work as independent variables, the study draws on status attainment and human capital traditions. Two critical issues are addressed: (1) are the pervasive positive correlations observed between academic track membership and outcomes such as the 10 studied here due to effects of track membership or due to selection into track on the basis of these 10 outcomes? (2) Given that part of these correlations are due to effects of track, are those effects mediated by type of course work? That is, for example, if academic track membership raises test scores, is it because those in the academic track take more academic courses? If effects of track are not mediated by course work, then the data lend indirect supoort to the view that informal discrimination (rather than formal course content) account for effects of tracking on the 10 outcomes. On the other hand, if course work does mediate effects of track membership, the results are not conclusive. Informal discrimination against nonacademic students may occur more strongly in nonacademic courses than in academic courses. Teachers may present diluted curriculum in nonacademic courses that have a majority of nonacademic students.

The theoretical stance adopted by several scholars who have investigated effects of tracking imply that track membership is an important intervening variable between status background and the 10 outcomes studied here. The idea that track is an intervening variable requires that track membership be influenced by status background. Thus, given that effects of track membership are observed, it is important also to examine effects of background on track.

Since the distribution of vocational and academic courses differs by gender, the statistical analyses are carried out separately for males and females. The separate analyses are conducted to allow for possibilities such as effects of course work taken in business and office on educational plans are different for males than for females.

Analysis

Presentation of the empirical analyses proceeds in four steps. First, a model for each outcome is summarized which contains as independent variables background variables, the lagged value of the dependent variable and a dummy variable indicating membership in the academic track.* The dependent variable in each model is the time 2 outcome. These anlayses correspond roughly to results that have been reported in the literature but using data sets other than HSB (Alexander, Cook, and McDill, 1978). These regression models are motivated by a continuous change model of the following form:

$$(1)\quad \frac{dy}{dt} = a_0 + a_1x_1 + \ldots + a_Jx_J + by + c(aca),$$

where

y = dependent variable (e.g., verbal test score, educational expectation, self esteem),

$\frac{dy}{dt}$ = instantaneous change rate in y with respect to time (derivative of y with respect to time),

x_j = exogenous variables assumed constant over time,

aca = academic curriculum track dummy variable (1=yes),

a_j,b,c = constants.

Integration of this equation yields a linear equation of the form to be analyzed by linear regression--

$$(2)\quad y_2 = a_0^* + a_1^*x_1 + \ldots + a_J^*x_J + b^*y_1 + c^*(aca)$$

where the starred coefficients are functions of the coefficients in the differential equation (1) and the length of time between measurements. The notation y_2,y_1 stands for observations on the dependent variable at time 2 and time 1, respectively. (See Coleman 1968; Doreian and Humman 1976).

The remaining analyses include a full complement of lagged endogenous variables, not just the lagged dependent variable of each equation. The set

---

*Initial data runs were carried out using two binary variables, one indicating academic track and one indicating vocational track. Results with these two track variables were essentially the same as those presented in text. The simpler versions of the models are therefore used.

of lagged endogenous variables includes base year values of all 10 outcomes studied here, perceived ability to complete college, parental career expectations of the youth, and average grade. The analysis is based on a simultaneous differential equation model in which all endogenous variables are depicted as affecting each other in an ongoing process over time.

An important conceptual difficulty with the differential equation model is that it cannot describe change in a dichotomous variable such as curriculum track, yet a priori considerations suggest that (1) track may change between the sophomore and senior years in high school, and (2) track probably depends on many of the 10 outcomes under study here (as well as partially determine them). An adequate conceptualization of a general change model that combines both discrete and continuous endogenous variables in a single simultaneous system has not appeared yet in the literature, and such development certainly lies outside the scope of this paper. For present purposes, it is assumed that track is a proxy for high school experiences that can be represented as continuous variables, and it is included as jointly dependent with the other 10 outcomes. Alternatively, one could assume track to be constant from the sophomore to the senior year. The resulting regressions that are derived from the differential equation model are the same irrespective of which assumption regarding track is made.*

The simultaneous system of change equations is written in the following terms:

$$\frac{dy_1}{dt} = a_{10} + a_{11}x_1 + \ldots + a_{1J}x_J + b_{11}y_1 + \ldots + b_{1K}y_K + c_1(\overline{aca}) ,$$

$$\vdots$$

$$(3) \quad \frac{dy_K}{dt} = a_{K0} + a_{K1}x_1 + \ldots + a_{KJ}x_J + b_{K1}y_1 + \ldots + b_{KK}y_K + c_K(\overline{aca}) ,$$

$$\frac{d(\overline{aca})}{dt} = a_{K+1,0} + a_{K+1,1}x_1 + \ldots + a_{K+1,J}x_J + b_{K+1,1}y_1 + \ldots + b_{K+1,K}y_K + C_{K+1}(\overline{aca}) ,$$

where

x_j = exogenous variables (assumed constant) ,

y_k = endogenous variables -- jointly dependent ,

$\overline{aca}$ = underlying continuous variables for which academic tract is a proxy, and

a_{kj}, $b_{kk'}$, C_k = constants.

---

*It should be noted, however, that interpretation of those regressions differ in critical respects depending on whether track is assumed fixed, and therefore exogenous, or endogenous. Calculation of total and indirect effects, equilibrium values, and effects of track on equilibrium values all depend in important respects on which assumption is made.

The notation for $\overline{aca}$ is distinct from that for th other jointly dependent variables to emphasize the fact that it is not the same as academic track--academic track here is conceptualized as a dichotomous indicator of $\overline{aca}$.

The solution to this set of equations is a set of linear equations of the following general form:

$$(4)\quad y_k(t) = a^*_{k0} + \sum_j^j a^*_{kj}x_j + \sum_{k'}^k b^*_{kk'}y_{k'} + C^*_k(\overline{aca})$$

On adding a disturbance the constant parameters in each equation $(a^*_{kj}, b^*_{kk'}, C_k)$ can be estimated with linear regression (Coleman 1968; Doreian and Hummon 1976; Hotchkiss 1979) or by maximum likelihood (Arminger 1983).

Analysis of the effects of background on track membership are based on the model in equations (3). However, as in chapter 4, total accumulated effects of background are estimated in the absence of controls for the endogenous variables, under the summptions of zero variance among the endogenous variables at the beginning of the process.

The analyses of the degree to which course work acts as a mediator of the effects of track are carried out simply by adding the course work variables to equations (4). If course work acts as an important intervening set of variables, then the coefficients on track membership should be reduced substantially when course work variables are added to the equations, and the effects of the course work variables should be present.

As in the general case, OLS regression will produce biased and inconsistent estimates of the starred coefficients in all the models presented here unless the disturbances are uncorrelated with all regressors in each equation (Judge et al. 1982). Such an assumption is particularly hard to entertain with respect to the lagged dependent variable (Hannan and Young 1977), but there are few practical atternativees to OLS unless more than two waves of data from a panel are available. The estimates presented in this paper are OLS.

Variables

The 10 dependent variables examined in previous chapters of this report are all included here. Their lagged values are used as controls in each equation. These variables are as follows:

- Verbal test score--average of standardized reading, writing and vocabulary tests. The input tests had means of 50 and standard deviations of 10.

- Math test score--average of 2 standardized mathematics tests, each with mean of 50 and standard deviation of 10.

- Science test score--the standardized HSB science test designed for the sophomores ($\overline{x}$=50, S.D.=10).

- Civics test score--the standardized HSB civics test score.

- Educational expectation--approximate number of years of education the youth expects to achieve.

- Occupational expectation--approximate status level in Duncan SEI units of major occupational group (14 categories) that the youth expects to achieve.

- Deportment index--an index of six variables indicating "misbehavior" in school. The input items are days tardy, days absent but not sick, cutting classes, discipline problems in school, suspension from school, and in trouble with the law. Each item was standardized to zero mean and unit variance prior to calculating the index value. High values indicate misbehavior.

- Self-esteem--an index composed of six questionnaire items that ask about matters such as one's feelings of self-worth. The items ask if the respondent takes a positive attitude toward himself or herself, whether the respondent feels he or she is capable of doing "things" as well as others, and whether the respondent is satisfied with himself or herself. Each component was standardized ($\overline{x}$=0, S.D.=1) prior to calculating the index value. High values indicate high self esteem.

- Locus of control--an index composed of six items that ask about matters such as one's sense of control over his or her future. The items ask for opinions about the relative importance of good luck in getting ahead, how frequently somebody stops one from getting ahead, whether it pays to plan ahead, and whether people should accept conditions as they are. Each component was standardized ($\overline{x}$=0, SD=1) prior to calculating the index value. High values indicate a sense of control over one's fate.

- Work values--an index composed of four questionnaire items that ask for opinions about the importance of steady work, making money, importance of leisure time and being successful in one's job. Each component was standardized ($\overline{x}$=0, S.D.=1) prior to calculating the index value. High values indicate strong emphasis on work.*

In addition to the 10 dependent variables defined above, lagged values of 5 endogenous variables were included on the right side of some sets of regressions. These variables are--

*Self esteem, locus of control, and work values are defined slightly differently than in previous chapters. The current definitions include more items, and those items were not standardized prior to calculating the index values.

- Perceived college ability--whether youth believes he or she has the ability to complete college. The variable was measured on a 5-point scale (5=definitely yes, 1=definitely not).

- Educational aspirations of mother for youth--number of years of schooling the youth's mother expected him or her to complete, as measured by youth's report.

- Mother's college expectation of youth--whether mother expected the youth to attend college after completing high school (1=yes), as measured by youth's report.

- Father's college expectation of youth--whether father expected youth to attend college after completing high school (1=yes), as reported by the youth.

- Grade average--youth's grade point average on a 4-point scale, as reported by the youth.

The exogenous variables are defined as follows:

- Exogenous background and personal characteristics--Hispanic ancestry--dummy variable representing ethnicity, 1 = Hispanic, 0 = nonHispanic.

- Race--dummy variable indicating black and nonblack; race of respondent, 1 = black.

- Gender--gender of respondent, 1 = female (used as an interaction variable).

- Father out of household--dummy variable set = 1 if no male guardian lived in the household, zero otherwise.

- Mother out of the household--dummy variable set = 1 if mother or female guardian was not in the household, zero otherwise.

- Father's occupation--approximate Duncat SEI for father's occupation based on 14 broad occupational categories.

- Father's education--approximate number of years of schooling completed by father.

- Mother's occupation--approximate Duncan SEI for mother's occupation based on 14 broad occupational categories (housewife was coded missing).

- Mother's education--approximate number of years of formal schooling completed by the respondent's mother.

- Number of siblings--number of brothers and sisters.

- Family income--family income in logarithmic units.

- Possessions index--number of possessions out of a checklist that respondents have in the home, including 2 or more cars or trucks, pocket calculator, newspaper, typewriter, place to study, more than 50 books, own bedroom, and electric dishwasher.

- Home ownership--dummy variable indicating whether parents own or rent their home (1=own).

- Number of rooms in the house--count of the number of rooms in the home.

All the above variables were taken from student reports. In addition, eight regional dummy variables were included as controls, and missing data dummies were included for both parent's education and occupation and for family income. Coefficients for the region dummies and missing data dummies are not displayed in the tables.

The curriculum variables are defined as follows:

- Academic track--self-report of whether the student was pursuing the academic curriculum track (or college preparatory), 1=yes.

- Number of years of mathematics taken between the sophomore and senior year, as reported by the student.

- Number of years of English courses taken between the sophomore and senior year, as reported by the student.

- Number of years of foreign language courses taken, as reported by the student.

- Number of years of history and civics courses taken, as reported by the student.

- Number of years of science courses taken, as reported by the student.

- Number of years of business and office courses taken, as reported by the student.

- Number of years of trade and industry courses taken, as reported by the student.

- Number of years of technical vocational courses taken, as reported by the student.

The first five types of course work represent academic course work; the last four represent vocational course work.

Findings

Table 21 displays the estimated effects of curriculum track on the 10 dependent variables, controling only for exogenous variables and the lagged value of the dependent variable (based on equation [2]). These effects are strong for both sexes, except on work values. The results do not differ appreciably by gender, except that academic track membership has a slightly stronger positive effect on the educational plans, occupational plans, self esteem, and deportment of males than of females. Perhaps the most striking observations in this table are that curriculum track does influence academic achievement even after lagged academic achievement is controlled. These observations if they hold under added controls, would support resu ts reported by Alexander, Cook, and McDill (1978) and by Rosenbaum (1975).

Selection into the academic track may depend on not only the controls included in the models reported in table 21, but also on an array of attitudinal and behavioral factors, including all 10 of the outcomes studied here, parental career expectations of the youth, grades in school, and perceptions of academic ability. To account for these possible confounding effects, additional controls were added to the models (see equations [4]). The revised regressions include as independent variables all the exogenous variables (family status, personal characteristics, and region), lagged dependent variable, lagged (sophomore) value of each of the 10 outcomes reported in table 21, plus mother's educational expectation of the youth, mother's expectation that the youth attend college, father's expectation that the youth attend college, youth's perceived ability to complete college, and youth's average grade--all measured at the sophomore year. The results of these calculations are reported in table 22.

Inclusion of controls for the additional lagged endogenous variables effected a marked reduction in the estimated coefficients associated with membership in the academic curriculum track on every outcome. For males, formerly highly significant effects on science test score, civics test score, occupational expectation, locus of control, and deportment are reduced to insignificance. The magnitude of the coefficients that remain significant all are reduced substantially. similarly large reductions of the coefficients occur for females, but the pattern of coefficients that are reduced to insignificance differs from that for males. For females, formerly significant coefficients on occupational expectation, self esteem, locus of control, and deportment are no longer significant. Lack of effects of track on locus of control and self esteem tend to undermine claims that nonacademic students suffer repeated indignities in school.

These observations have important implications for published work in which it is concluded that track affects variables such as educational plans, college attendance, and IQ scores (e.g., Alexander, Cook and McDill 1978; Rosenbaum 1976). None of these studies control for an extensive set of predetermined variables as done in the regressions reported in table 22. Consequently, conclusions of those studies must remain open to serious doubt.

Despite these reductions in the estimated effects of track, a residue of significant and substantively important effects remains. The impact of

TABLE 21

EFFECTS OF ACADEMIC TRACK ON 10 OUTCOMES
CONTROLLING FOR EXOGENOUS VARIABLES AND LAGGED DEPENDENT VARIABLE

	Effects of Academic Track			
	Females		Males	
Dependent Variable	Standardized Coefficients	Unstandardized Coefficients	Standardized Coefficients	Unstandardized Coefficients
Verbal test score	.0487	.943***	.0516	1.059***
Math test score	.0987	1.974***	.0938	2.147***
Science test score	.0878	1.809***	.0574	1.278***
Civics test score	.1280	2.698***	.1237	2.847***
Educational expectation	.0986	.4943***	[illegible]317	.702***
Occupational expectation	.0589	2.569***	.1073	5.374***
Self esteem	.0254	.0332*	.0684	.0879***
Locus of control	.0624	.0733***	.0758	.0963***
Work values	- .0017	- .0009	- .0180	- .0094
Deportment	- .0279	- .1926*	- .0453	- .4917***

NOTE. Each equation contains controls for race, ethnicity, and 11 exogenous variables, including parental status variables and family income. To conserve space, coefficients of these variables are not tabulated. (See list of independent variables in table 23.)

* $p \leq .01$.
** $p \leq .001$.
*** $p \leq .0001$.
(two tailed test)

TABLE 22

EFFECTS OF ACADEMIC TRACK ON 10 OUTCOMES
CONTROLLING FOR EXOGENOUS VARIABLES AND AN ARRAY OF LAGGED
ENDOGENOUS VARIABLES, INCLUDING LAGGED DEPENDENT VARIABLE

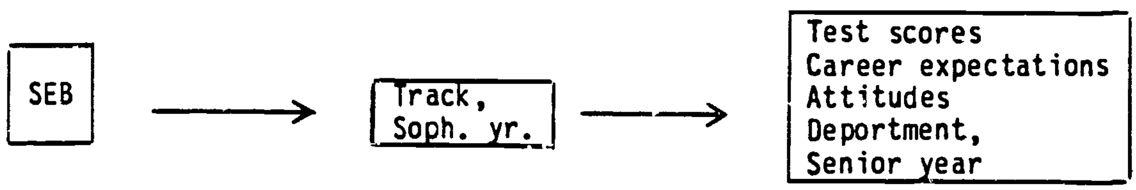
	Effects of Academic Track			
	Females		Males	
Dependent Variable	Standardized Coefficients	Unstandardized Coefficients	Standardized Coefficients	Unstandardized Coefficients
Verbal test score	.0220	.4263***	.0168	.3456*
Math test score	.0455	.9111***	.0437	1.0008***
Science test score	.0223	.4591**	- .0048	- .1073
Civics test score	.0293	.6170**	.0082	.1883
Educational expectation	.0415	.2081***	.0635	.3390**
Occupational expectation	.0005	.0211	.0229	1.149
Self esteem	.0017	.0023	.0321	.0412**
Locus of control	- .0015	- .0017	.0041	.0052
Work values	.0116	.0062	.0022	.0012
Deportment	- .0147	- .1017	- .0203	- .2258

NOTE. Each equation contains controls for race, ethnicity, and 11 exogenous variables, including parental status variables and family income. To conserve space, coefficients of these variables are not tabulated. (See list of independent variables in table 23.)

* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.
(two tailed test)

membership in the academic track has strong effects on the math test scores and educational expectations of both sexes. Small but statistically significant effects on verbal test score and self esteem are present for males.* For females, statistically significant effects also occur on verbal, science, and civics test scores.

Given that membership in the academic curriculum track does exercise independent influence on some of the 10 outcomes, it is of interest to determine effects of statis background (family status and personal characteristics) on base year curriculum track. The fundamental idea in so doing is to complete the links in the following chain model:



where SEB stands for socioeconomic background. Alexander and McDill (1976) view track as an important intervening variable of this sort.**

The intervening variable model depicted above excludes variables such as test scores, school grades, and career phans prior to the sophomore year that might be expected to intervene between SEB and track in the sophomore year. Effect estimates that exclude these intervening variables should be interpreted as total effects of SEB accumulated over the entire life of the process. To do so requires three pivotal assumptions: (1) background variables remain constant over time, (2) coefficients in the model of change are constant over time, and (3) the variance of the outcome measures is zero at the beginning of the process. (See chapter 4 of this report.) The assumption of homogeneity at the beginning of the process may appear more unrealistic than it actually is. An endogenous variable such as verbal test score measures verbal skills. Verbal skills are nonexistent at birth; hence, there is perfect homogeneity. The homogeneity assumption nevertheless presents some troubling conceptual issues. Discussion of those issues lies beyond the scope of this chapter, but the issues probably are not more troublesome than many other assumptions typically required for causal inference. One of the chief values of the differential equation model developed in chapter 4 is that the assumptions are made explicit.

Given that total effects of SEB on track are observed, it is of interest to examine by what mechanisms they operate. Do academic achievement, career expectations, and the like account for these effects? While the HSB data do

*The effect on occupational expectations of males very nearly reaches significance at the one percent level ($p \leq .0131$).

**They extend the chain model to post high-school outcomes.

not contain measures of likely intervening variables collected prior to the sophomore year, it is feasible to gain considerable insight into the intervening mechanisms by estimating models in which senior year track is the dependent variable, and SEB, sophomore track, and the variables hypothesized to intervene between SEB and track are included as independent variables. Given that the linear differential equation model were an exactly accurate depiction of the process, these estimates would generate the same expected values of the coefficients as those obtained from data colected earlier in repondents' lives. Presuming that the differential equation model is only a rough approximation, the estimates using sophomore and senior year data must also be viewed as rough approximations of results that would be obtained with eighth grade and sophomore data.

Table 23 displays four sets of estimated effects of SEB on track. The first column shows estimates of total effects of SEB. Here sophomore track is the dependent variable, and the only independent variables are SEB (and region dummies). In the second column, senior year track is the dependent variable. SEB, region dummies (coefficients not shown), sophomore year track, and a full complement of hypothesized intevening variables are included as independent variales. In column 3, the only intevening variables are measures of academic achievement--verbal test score, math test score, science test score, civics test score, and grade average--all measured at the sophomore year. Column 4 presents estimates which exclude these achievement variables from the equations but include all the remaining intervening variables. The intervening variables in these equations are all measures of career expectations, attitudes and deportment. Comparing coefficients on SEB in the first two columns shows the extent to which the total effects of SEB on track are mediated by all the intervening variables combined. Comparison of the SEB coefficients in the last 2 columns indicates the relative impertance of achievement and attitudes (mostly career expectations) in mediating effects of SEB on track. The set of interveners which effects the largest reduction in the total effects of SEB comprises the more important set of intervening mechanisms.

Irrespective of gender, total effects of family background on track are substantial. All the major components of family background--parents education and occupation, family income, number of siblings, and possessions exhibit highly statistically significant coefficients with the expected signs. The magnitude of effects of both parents' education and (log of) family income are particularly strong. In contrast, effects of race and ethnicity are not significant when the other background variables are controlled.

A large part of the total effects of SEB are indeed mediated by the intervening controls introduced in the models reported in column 2 of table 23. Of the formerly significant coefficients, only those associated with father's education and family income remain significant with all intervening variables included and for both sexes. Mother's education remains significant at the .01 level for females and is nearly so for males ($p \leq .013$). Additionally, a small positive effect of race on membership in the academic track is now observed. The total effect of race is approximately zero due to its negative impact on family status and tests scores, its positive effect on career expectations, and the positive effects of both status, test scores, and expectations on academic track.

TABLE 23

EFFECTS OF BACKGROUND ON CURRICULUM TRACK

	Females			
Independent Variables	Total Effects	Control for All Lagged Endogenous Vbls	Control for Academic Achievement	Control for Attitudes
Race (1=black)	.0024(.0031)	.0325(.0433)**	.0756(.1007)***	-.0164(-.0218)
Ethnicty (1=Hispanic)	-.0065(-.0101)	.0169(.0270)	.0304(.0486)***	-.0085(-.0136)
Father's occupation	.0557(.0011)***	.0192(.0004)	.0257(.0005)	.0297(.0006)*
Father's education	.2503(.0237)***	.0828(.0081)***	.1252(.0122)***	.1104(.0107)***
Mother's occupation	.0419(.0008)**	-.0038(-.0001)	.0082(.0002)	-.0004(0.0000)
Mother's education	.1321(.0175)***	.0885(.0120)***	.1203(.0163)***	.0970(.0131)***
No. of siblings	-.0434(-.0096)	.0015(.0003)	-.0091(-.0021)	-.0030(-.0007)
Father out of household (1=yes)	.0129(.0159)	[illegible](.0110)	.0035(.0044)	.0081(.0102)
Mother out of household (1=yes)	-.0320(-.0688)***	.0015(.0033)	-.0028(-.0061)	-.0015(-.0033)
Log of family income	.1124(.0535)***	.1379(.0672)***	.1639(.0800)***	.1542(.0752)***
No. of possessions	.0412(.0959)***	-.0178(-.0425)	-.0033(-.0079)	-.0202(-.0483)
Home ownership (1=yes)	.0208(.0234)	-.0059(-.0068)	-.0058(-.0067)	-.0040(-.0048)
No. of rooms in home	.0178(.0048)	-.0078(-.0021)	-.0083(-.0022)	-.0047(-.0012)

TABLE 23--Continued

Independent Variables	Males: Total Effects	Males: Control for All Lagged Endogenous Vbls	Males: Control for Academic Achievement	Males: Control for Attitudes
Race (1=black)	.0101(.0133)	.0319(.0439)**	.0685(.0942)***	-.0145(-.0200)
Ethnicity (1=Hispanic)	-.0072(-.0101)	.0084(.0124)	.0198(.0292)	-.0146(-.0214)
Father's occupation	.0698(.0014)***	.0079(.0002)	.0305(.0006)*	.0160(.0003)
Father's education	.2366(.0227)***	.0854(.0086)***	.1358(.0136)***	.1161(.0116)***
Mother's occupation	.0490(.0009)**	.0096(.0002)	.0170(.0003)	.0177(.0003)
Mother's education	.1334(.0151)***	.0481(.0057)	.0666(.0079)**	.0548(.0065)*
No. of siblings	-.0370(-.0077)***	.0037(.0008)	-.0031(-.0007)	-.0011(-.0002)
Father out of household (1=yes)	-.0071(-.0088)	-.0022(-.0029)	-.0027(-.0035)	-.0086(-.0112)
Mother out of household (1=yes)	-.0168(-.0328)	.0055(.0112)	.0062(.0126)	.0013(.0026)
Log of family income	.0717(.0353)***	.0811(.0416)***	.1101(.0504)***	.0715(.0366)***
No. of possessions	.0386(.0861)***	-.0023(-.0054)	.0116(.0269)	-.0049(-.0113)
Home ownership (1=yes)	-.0040(-.0045)	-.0303(-.0361)***	-.0342(-.0407)***	-.0241(-.0287)*
No. of rooms in home	.0365(.0085)***	.0133([illegible])	.0092(.0023)	.0213(.0052)

NOTE. Main entries are standardized coefficients; those in parentheses are unstandardized.

* $p \leq .01$.
** $p \leq .001$.
*** $p \leq .0001$.
(two tailed test)

Even though the direct effect of father's education remains significant for both sexes, and the effect of mother's education is significant for females and nearly so for males, the magnitudes of these effects as compared to corresponding total effects are reduced dramatically. The effect of father's education reduces from .237 to .085 (standardized coefficients) for males and from .250 to .083 for females. The reduction on mother's education is from .133 to .048 for males and from .132 to .089 for females.

In striking contrast, the effects of family income actually increase when the intervening controls are added. These apparent anomolies are due to the following facts: (1) the dependent variable in the equations estimating total effects (column 1) is track measured at time 1, (2) estimates of direct effects (columns 2-4) of SEB on track were carried out with time 2 track as the dependent variables and (3) the total effect of income on track increases substantially from the sophomore to the senior year. For males the increase in that total effect is from .072 (sophomore track) to .155 (senior track). For females, corresponding effects of income on track are .112 (sophomore track) and .253 (senior track). (These figures are standardized regression coefficients.) For both sexes, the effects of income more than double in the last two years of high school!* Apparently the reality of financing a college education weighs increasingly heavy as the time approaches to begin college.

It is important to notice that the realities of financial pressures affect track placement of females much more strongly than they do males. An increase of one logarithmic unit of income increases the chance of males being in the academic track by about 4.6 percent; whereas the corresponding figure is 6.7 percent for females. In dollar units, an increase in family income from 20,000 to 54,366 dollars is associated with a 4.6 percent increase in the chance of being in the academic track for males, and a 6.7 percent increase for females. Because the effects are not linear, dropping income from 20,000 dollars decreases the chance of being in the academic track more rapidly than increasing income increases the chance.

The last stage of the analyses is to add course work to the equations for each of the 10 outcomes. Results of these calculations are shown in table 24. Most of the statistically significant effect estimates in table 22 retain significance when controls for course work are added. The most notable exception is the effect of track on educational expectations of females. The estimated effect without course work in the equations is .0413; this is reduced to .0187 when course work is added and p falls just above the .01 significance level ($p \leq .0142$). The estimated effect of track on science test scores of females also drops below statistical significance when course work variables are included, but, again, the probability level is nearly significant even with course work included ($p \leq .0103$). In broad summary, course work accounts for part of the effects of track, but not all of them. Statistically significant and substantively important effects of track cannot be fully accounted for by the pattern of courses that students take during their last two years of high school.

---

*The dynamic model expressed by the differential equation predicts a slight increase, but nothing approaching a doubling.

BEST COPY AVAILABLE

TABLE 24

EFFECTS OF CURRICULUM TRACK AND COURSE WORK ON ID OUTCOMES

Females
Dependent Variables (time 2 measures)

	Verbal Test Scores	Math Test Scores	Science Test Scores	Civics Test Scores	Educational Expectation	Occupational Expectation	Self Esteem	Locus of Control	Work Values	Department
VERBAL1	0.5756***	0.1471***	0.2093***	0.3271***	0.0682***	0.0859***	0.0135	0.1723***	-0.0551*	0.0201
	(0.6096)	(0.1609)	(0.2359)	(0.3772)	(0.0187)	(0.2047)	(0.0010)	(0.0111)	(-0.0016)	(0.0076)
MATHSD21	0.0714***	0.4652***	0.0850***	0.0523***	0.0399***	-0.0050	0.0000	-0.0045	-0.0172	-0.0034
	(0.0762)	(0.5131)	(0.0975)	(0.0608)	(0.0110)	(-0.0119)	(0.0000)	(-0.0003)	(-0.0005)	(-0.0013)
SCINSD21	0.0761***	0.0625***	0.3759***	0.0751***	0.0181	0.0025	-0.0014	0.0387*	-0.0696***	0.0044
	(0.0733)	(0.0620)	(0.3847)	(0.0787)	(0.0045)	(0.0054)	(-0.0001)	(0.0023)	(-0.0018)	(0.0015)
CIVCSD21	0.0526***	0.0065	0.0087	0.1474***	0.0163	0.0186	0.0071	0.0173	0.0153	0.0034
	(0.0506)	(0.0064)	(0.0089)	(0.1543)	(0.0041)	(0.0403)	(0.0005)	(0.0010)	(0.0004)	(0.0012)
EDASP1	0.6044	0.0473***	0.0065	0.0118	0.2862***	0.0499**	0.0114	0.0112	0.0197	-0.0434*
	(0.0162)	(0.1784)	(0.0329)	(0.0468)	(0.2706)	(0.4097)	(0.0028)	(0.0025)	(0.0020)	(-0.0563)
OCCASP1	0.0150**	-0.0127	-0.0022	0.0285***	0.0219*	0.1406***	-0.0073	0.0205	0.0010	-0.0273*
	(0.0071)	(-0.0062)	(-0.0011)	(0.0148)	(0.0027)	(0.1507)	(-0.0002)	(0.0096)	(0.0000)	(-0.0046)
CONCPT1	-0.0249***	-0.0266***	-0.0264***	-0.0346***	0.0065	0.0252*	0.4274***	0.0871***	-0.0086	-0.0315**
	(-0.3588)	(-0.3951)	(-0.4049)	(-0.5427)	(0.0242)	(0.8174)	(0.4144)	(0.0760)	(-0.0034)	(-0.1614)
LOCUS1	0.0616***	0.0200**	0.0582***	0.0712***	0.0276**	0.0143	0.0584***	0.3289***	-0.0080	0.0093
	(1.0225)	(0.3562)	(1.0287)	(1.2863)	(0.1125)	(0.5325)	(0.0653)	(0.3308)	(-0.0037)	(0.0551)
WORKVAL1	-0.0247***	-0.0164**	-0.0176*	-0.0096	0.0015	-0.0124	-0.0079	0.0012	0.2451***	0.0175
	(-0.8957)	(-0.6151)	(-0.6805)	(-0.3781)	(0.0138)	(-1.0162)	(-0.0194)	(0.0027)	(0.2454)	(0.2260)
SMDEPRT1	-0.0105	-0.0084	-0.0129	-0.0077	-0.0149	-0.0078	0.0120	0.0055	0.0044	0.3673***
	(-0.0311)	(-0.0257)	(-0.0406)	(-0.0249)	(-0.0114)	(-0.0521)	(0.0022)	(0.0010)	(0.0004)	(0.3867)
COLABL1	-0.0013	0.0063	0.0027	0.0088	0.0479***	0.0153	0.0599***	0.0600***	0.0064	0.0273
	(-0.0125)	(0.0600)	(0.0272)	(0.0897)	(0.1157)	(0.3220)	(0.0376)	(0.0339)	(0.0017)	(0.0906)
ACADMIC1	0.0227***	0.0262***	0.0169	0.0325***	0.0189	-0.0029	0.0050	0.0012	0.3178	-0.0119
	(0.4391)	(0.5241)	(0.3482)	(0.6860)	(0.0949)	(-0.1280)	(0.0065)	(0.0014)	(0.0095)	(-0.0823)
YMATH22	-0.0256***	0.1033***	-0.0213*	-0.0149	0.0696***	-0.0102	-0.0122	-0.0061	0.0197	-0.0396***
	(-0.2490)	(1.0365)	(-0.2195)	(-0.1573)	(0.1750)	(-0.2232)	(-0.0080)	(-0.0035)	(0.0053)	(-0.1370)
YENGL22	0.0156**	-0.0229***	0.0012	0.0075	0.0290***	0.0399***	0.0142	0.0202	0.0009	-0.0015
	(0.2490)	(-0.3770)	(0.0199)	(0.1316)	(0.1199)	(1.4310)	(0.0152)	(0.0195)	(0.0004)	(-0.0083)
YFORLNG2	0.0141*	0.0265***	0.0031	0.0127	0.0353***	0.0328**	-0.0211	-0.0053	0.0049	-0.0150
	(0.0727)	(0.1409)	(0.0169)	(0.0711)	(0.0471)	(0.3802)	(-0.0073)	(-0.0017)	(0.0007)	(-0.0275)
YHIST22	-0.0022	-0.0229***	0.0009	0.0348***	-0.0190*	0.0009	0.0039	-0.0056	-0.0151	0.0156
	(-0.0263)	(-0.2778)	(0.0107)	(0.4440)	(-0.0577)	(0.0249)	(0.0031)	(-0.0040)	(-0.0049)	(0.0653)
YSCIEN22	0.0168*	0.0326***	0.0584***	-0.0062	0.0531***	0.0060	0.0129	0.0090	-0.0131	-0.0300*
	(0.1505)	(0.3228)	(0.5950)	(-0.0644)	(0.1316)	(0.1291)	(0.0083)	(0.0052)	(-0.0035)	(-0.1022)
YBUSOF22	0.0156**	-0.0167*	-0.0127	0.0336***	-0.0399***	0.0214	0.0083	0.0138	0.0466***	-0.0612***
	(0.1246)	(-0.1378)	(-0.1080)	(0.2925)	(-0.0825)	(0.3841)	(0.0044)	(0.0067)	(0.0103)	(-0.1743)
YTRDIN22	0.0006	-0.0079	0.0107	0.0064	-0.0020	-0.0217	0.0063	0.0065	0.0067	0.0385***
	(0.0109)	(-0.1427)	(0.1983)	(0.1212)	(-0.0092)	(-0.8528)	(0.0074)	(0.0069)	(0.0032)	(0.2391)
YTECNC22	-0.0006	0.0050	0.0005	-0.0114	-0.0184*	-0.0383***	0.0032	0.0080	0.0058	0.0110
	(-0.0109)	(0.0970)	(0.0107)	(-0.2352)	(-0.0902)	(-1.6296)	(0.0040)	(0.0092)	(0.0030)	(0.0804)
YOTHVC22	-0.0221***	-0.0136*	-0.0035	-0.0190*	-0.0037	-0.0189	-0.0043	0.0033	0.0140	0.0084
	(-0.2129)	(-0.1350)	(-0.0356)	(-0.1993)	(-0.0093)	(-0.4093)	(-0.0028)	(0.0020)	(0.0037)	(0.0290)

BEST COPY AVAILABLE

TABLE 24--Continued

	Males Dependent Variables (time 2 measures)									
	Verbal Test Scores	Math Test Scores	Science Test Scores	Civics Test Scores	Educational Expectation	Occupational Expectation	Self Esteem	Locus of Control	Work Values	Department
VERBAL1	0.5583***	0.1150***	0.1976***	0.2909***	0.0752***	0.1021***	0.0269	0.1180***	-0.0601**	0.0250
	(0.6004)	(0.1378)	(0.2305)	(0.3506)	(0.0210)	(0.2679)	(0.0018)	(0.0079)	(-0.0017)	(0.0142)
MATHSD21	0.0827***	0.5037***	0.1025***	0.0664***	0.0499***	-0.0234	0.0082	-0.0361*	-0.0358*	-0.0112
	(0.0815)	(0.5538)	(0.1097)	(0.0734)	(0.0128)	(-0.0562)	(0.0005)	(-0.0022)	(-0.0010)	(-0.0059)
SCINSD21	0.0997***	0.0713***	0.3994***	0.1194***	0.0205	0.0002	0.0130	0.0879***	-0.0400*	0.0174
	(0.0935)	(0.0745)	(0.4064)	(0.1255)	(0.0050)	(0.0004)	(0.0008)	(0.0051)	(-0.0010)	(0.0086)
CIVCSD21	0.0471***	-0.0038	0.0241*	0.1452***	0.0140	0.0154	0.0166	0.0433***	0.0156	0.0018
	(0.0440)	(-0.0040)	(0.0244)	(0.1519)	(0.0034)	(0.0351)	(0.0010)	(0.0025)	(0.0004)	(0.0009)
EDASP1	0.0191*	0.0276**	0.0127	0.0331*	0.2694***	0.0893***	0.0320	0.0231	0.0053	-0.0405*
	(0.0713)	(0.1144)	(0.0511)	(0.1381)	(0.2606)	(0.8112)	(0.0075)	(0.0053)	(0.0005)	(-0.0797)
OCCASP1	0.0134	-0.0012	-0.0050	0.0005	0.0386***	0.2112***	0.0014	0.0319**	-0.0128	0.0117
	(0.0055)	(-0.0006)	(-0.0022)	(0.0002)	(0.0041)	(0.2127)	(-0.0000)	(0.0008)	(-0.0001)	(0.0026)
CONCPT1	-0.0056	-0.0007	0.0122	-0.0170	-0.0083	0.0314	0.3575***	0.1311***	0.0189	0.0018
	(-0.0088)	(-0.0125)	(0.2090)	(-0.2997)	(-0.0339)	(0.0557)	(0.3529)	(0.6387)	(0.0076)	(0.0152)
LOCUS1	0.0394***	0.0126	0.0343***	0.0436***	-0.0070	0.0236	0.0499***	0.2698***	-0.0123	0.0076
	(0.6580)	(0.2350)	(0.6213)	(0.8171)	(-0.0303)	(0.9624)	(0.0522)	(0.2792)	(-0.0053)	(0.0674)
WORKVAL1	-0.0113	-0.0110	-0.0031	-0.0061	-0.0082	0.0019	0.0122	-0.0141	0.2203***	0.0235*
	(-0.4237)	(-0.4624)	(-0.1251)	(-0.2575)	(-0.0799)	(0.1728)	(0.0289)	(-0.0329)	(0.2117)	(0.4672)
SNDEPRT1	-0.0240***	-0.0200***	-0.0237**	-0.0156	-0.0047	-0.0073	0.0115	-0.0004	-0.0121	0.3424***
	(-0.0573)	(-0.0553)	(-0.0613)	(-0.0417)	(-0.0029)	(-0.0424)	(0.0017)	(-0.0001)	(-0.0007)	(0.4317)
COLABL1	0.0315***	0.0300***	0.0194*	0.0288*	0.0633***	0.0330*	0.0654***	0.0669***	-0.0104	-0.0281
	(0.2782)	(0.3028)	(0.1853)	(0.2850)	(0.1451)	(0.7110)	(0.0361)	(0.0365)	(-0.0023)	(-0.1309)
ACADMIC1	0.0150*	0.0263***	-0.0041	0.0673	0.0411***	0.0063	0.0327*	0.0020	0.0043	-0.0123
	(0.3089)	(0.6023)	(-0.0912)	(0.1602)	(0.2192)	(0.3155)	(0.0420)	(0.0025)	(0.0022)	(-0.1333)
YMATH22	-0.0277***	0.0932***	-0.0185	-0.0310**	0.0506***	0.0331*	0.0176	0.0125	0.0130	-0.0550***
	(-0.2682)	(1.0051)	(-0.1944)	(-0.3362)	(0.1272)	(0.7799)	(0.0107)	(0.0075)	(0.0032)	(-0.2813)
YENGL22	0.0155*	-0.0207**	-0.0015	0.0257*	0.0079	0.0138	0.0121	0.0059	-0.0112	-0.0011
	(0.2233)	(-0.3311)	(-0.0226)	(0.4140)	(0.0293)	(0.4841)	(0.0108)	(0.0053)	(-0.0041)	(-0.0081)
YFORLNG2	-0.0022	0.0056	-0.0424***	-0.0149	0.0232**	0.0025	-0.0112	-0.0092	-0.0145	0.0257*
	(-0.0118)	(0.0334)	(-0.2448)	(-0.0887)	(0.0320)	(0.0318)	(-0.0037)	(-0.0030)	(-0.0020)	(0.0722)
YHIST22	0.0151*	-0.0120	0.0014	0.0330***	0.0143	-0.0024	-0.0055	-0.0040	-0.0002	-0.0061
	(0.1757)	(-0.1561)	(0.0173)	(0.4319)	(0.0433)	(-0.0678)	(-0.0040)	(-0.0029)	(-0.0001)	(-0.0375)
YSCIEN22	0.0035	0.0332***	0.0641***	0.0023	0.0583***	0.0351**	0.0080	0.0093	0.0091	-0.0227
	(0.0330)	(0.3493)	(0.6554)	(0.0238)	(0.1426)	(0.8059)	(0.0047)	(0.0054)	(0.0022)	(-0.1128)
YBUSOF22	0.0085	-0.0216***	-0.0170*	0.0151	0.0250***	0.0379***	0.0098	-0.0015	0.0206	-0.0037
	(0.0965)	(-0.2735)	(-0.2095)	(0.1924)	(0.0738)	(1.0483)	(0.0069)	(-0.0011)	(0.0060)	(-0.0223)
YTRDIN22	-0.0229***	-0.0230***	-0.0020	-0.0190	-0.0562***	-0.0675***	0.0120	0.0030	0.0088	0.0177
	(-0.1883)	(-0.2114)	(-0.0176)	(-0.1751)	(-0.1202)	(-1.3564)	(0.0062)	(0.0015)	(0.0018)	(0.0770)
YTECNC22	-0.0010	0.0140*	0.0188*	-0.0084	0.0014	-0.0271*	0.0093	0.0049	-0.0137	0.0106
	(-0.0097)	(0.1573)	(0.2057)	(-0.0948)	(0.0036)	(-0.6643)	(0.0059)	(0.0031)	(-0.0035)	(0.0566)
YOTHVC22	-0.0162**	-0.0171**	0.0113	-0.0237*	-0.0092	-0.0167	-0.0107	-0.0281**	0.0068	0.0148
	(-0.1475)	(-0.1740)	(0.1117)	(-0.2419)	(-0.0217)	(-0.3704)	(-0.0061)	(-0.0159)	(0.0016)	(0.0714)

TABLE 24--Continued

NOTE. 1. Coefficients not shown in parentheses are standardized OLS regression coefficients.

2. Coefficients in parentheses are corresponding unstandardized coefficients.

3. Each equation contains controls for 8 region dummies and 13 exogenous variables, including race, ethnicity, family status, and family income. Coefficients for these controls are not tabulated, to conserve space.

* $p \leq .01$.
** $p \leq .001$.
*** $p \leq .0001$.
(two-tailed tests)

Definition of independent variables

VERBAL1 = Verbal test score (t1)
MATHSD21 = Math test scores (t1)
SCINSD21 = Science test score (t1)
CIVICSD21 = Civics test score (t1)
EDASP1 = Educational expectation (t1)
OCCASP1 = Occupational expectation (t1)
CONCPT1 = Self esteem (t1)
LOCUS1 = Locus of control (t1)
WORKVAL1 = Work values (t1)
SMDEPRT1 = Deportment (t1)
COLABL1 = Perceived college ability (t1)
ACADMIC1 = Academic curriculum track (t1)
YMATH22 = Number of math courses
YENG22 = Number of English courses
YFORLNG1 = Number of foreign language courses
YHIST22 = Number of history and civics courses
YSCIEN22 = Number of science courses
YBUSOF22 = Number of business and office courses
YTRDIN22 = Number of trade/industry courses
YTECHC22 = Number of technical courses

Hypotheses proposed by Rosenbaum (1976) Oakes (1983) and others indicating alternative mechanisms to account for tracking effects are not entirely contradicted by these findings, but they are not strongly supported. These authors argue that numerous discriminations against nonacademic students account for effects of track. While the evidence presented here lends indirect support to these claims, that evidence is not compelling. First, effects of track that cannot be accounted for by mechanisms other than direct discriminations are small. Second, we have seen that estimates of tracking effects are sensitive to the set of controls that are included. It is possible that a more complete set of controls would further reduce estimated effects of track. Third, convincing evidence that discrimination against nonacademic track students is an important reason for the effects of track observed here requires direct measures of discrimination (see Oakes [1983] on this point). Fourth, effects of track on self esteem and locus of control are essentially zero. On the other hand, the measure of track used here is self report. As Rosenbaum (1980) shows, a measure of track taken from student transcripts produces larger effects than a self-report measure. Further, equations estimated in this paper do contain a much more extensive set of controls than most past work on the topic.

The estimated effects of the different types of course work exhibit some curious patterns. It is certainly sensible that number of years of courses in English would have a positive effect on verbal test score, but it is difficult to explain why number of years of math should reduce verbal test score--for both sexes. Likewise, why should years of English reduce math test score for both sexes? No effects would not be particularly surprising, but negative effects are puzzling. It would not be difficult to explain negative effects of math courses on verbal test if number of courses in English (and many other types of courses) were not controlled. In the absence of controls, a small negative effect might be predicted because as number English courses increases the time left to take math courses decreases. With number of English courses constant, however, this explanation is not satisfactory. Of course, an entirely analogous argument applies to the negative effect of number of math courses on verbal test.

It is even more difficult to explain the significant negative effect of number of math courses on science test scores of females and nearly significant effect ($p \leq .0122$) for males. Likewise the comparatively strong negative coefficient of math courses on civics test score of males is not sensible. This coefficient also is negative for females but not statistically significant ($p \leq .0777$). The significant negative effect of number of years of foreign language on science test scores of males is equally inexplicable. Foreign language has a positive effect on math test scores of women. The latter effect is not quite as perplexing, but why foreign language instruction should affect math achievement in any manner is unclear. Why it would have opposite effects on males and females is even less clear.

Certainly, many of the effects of course work are sensible. Years of English raise verbal test score. Years of math raise math test score. Years of science raise science test score. Years of civics and history raise civics test score. All these coefficients are positive and highly significant for both sexes. Moreover, years of course work in academic elective subjects such as math, science, and foreign language raise educational expectation, as one would expect. Similar though weaker and less consistent effects are observed on occupational expectation level.

There is a tendency for number of years of courses taken in elective academic subjects--math, science, and foreign language--to improve deportment in school (the summary deportment measure is an index of "misbehavior" in school). Math and science courses improve deportment for both males and females. Foreign language courses also tend to do so for females but the coefficient is not statistically significant ($p \leq .0981$). On the other hand, years of foreign language leads males to misbehave more.

The pattern of effects of vocational course work is particularly interesting. One of the most salient findings is that vocational courses exhibit mixed effects. Business and office courses raise verbal test score for females but not for males. They tend to deflate math and science test scores but raise civics test score, for both genders. Technical courses raise math and science scores of males but not of females. Trade and industry courses and, especially, the residual "other vocational courses" tend to deflate test scores and career plans. The pattern of effects of business and office courses on career plans and work values is especially noteworthy. Business and office courses deflate educational expectation and increase work values for females. For males, business and office courses <u>raise</u> educational and occupational expectations and also raise work values. It appears that business and office course work serves different functions for the two sexes. For females, it prepares them for middle and lower level office work with short or nonexistent career ladders. For males, it prepares them for upper level white collar jobs that require college education.

The evidence regarding effects of vocational courses suggests the following general conclusions: Vocational courses may lead to desirable outcomes like improving basic skills and work values, but they may also lead to deleterious results. Whether results of vocational courses are favorable or not depends on which vocational courses are taken and whether the student is male or female. These findings suggest that careful examination of vocational education in high school is warranted. We need to know much more than we now do about circumstances when vocational education is helpful and when it is not.

Summary and Conclusions

This chapter examines the effects of curriculum track and course work on 10 outcomes, including 4 achievement test scores, educational and occupational expectations, deportment, self-esteem, locus of control, and work values. All analyses are conducted separately by gender. Two basic issues are addressed: (1) Can the correlation between curriculum track on the one hand and test scores and career expectations on the other be attributed primarily to selection into track according to past achievement and expectations? (2) To what extent are the effects of track mediated by course work?

The answer to the first question is a tentative no. With time 2 outcomes as dependent variables and an array of SEB variables, lagged outcome measure, and membership in the academic curriculum track as predictors, large effects of track are observed on all the outcomes. But when a full complement of lagged endogenous variables--test scores, career plans, self esteem, locus of control, work values, school deportment, grades in school, belief in ability to complete college, and parent's educational expectations--are included in the equations, direct effects of track are reduced substantially. Some significant direct effects do remain, however. The strongest remaining effects are positive on educational expectations and math test scores of both males and females. Other scattered but small effects occur on test scores and self esteem (the latter for males only). It is noteworthy that effects of track on the attitudinal variables--self esteem and locus of control--are small on nonexistent after controls for lagged endogenous variables are included. These results suggest that discremination against nonacademic students may not be as pervasive as many writers have claimed.

The course work variables are measures of number of years of courses taken in nine academic and vocational categories between the sophomore and senior years of high school. The nine categories are math, English, foreign language, science, civics and history, business and office,trade and industry, technical, and "other vocational." Since these are measures of courses taken after the time 1 measurements were collected, estimates of effects of sophomore track on senior outcomes are viewed as total effects of track.

Effects of track are examined under controls for all nine categories of course work. For the most part, the same pattern of track effects observed prior to controls for course work persists after addition of the controls. The most notable exception is that effect of track on educational expectation of females is reduced to nonsignificance ($p \leq .0142$) by controls for course work. Prior to adding the controls, this effect was large and highly significant ($\beta = .0415$, $p \leq .0001$). Controls for course work also reduce the magnitudes of most of the effects of track membership.

It is found that socioeconomic background (SEB) exercises strong total effects on track membership. while some direct effects persist after controls for base year test scores, career plans, and attitudes are added to these equations, much of the total effects of SEB or track are mediated by these intervening variables. Parent's education retains a strong direct effect, and family income has a stronger direct than total effect, however. The latter anomaly is due to the fact that total effect of income increases dramatically (doubles) in the last two years of high school. It is also noteworthy that effect of family income on curriculum track of females is stronger than for males. This finding is consistent with the view that parents believe thaty college education is more important for their sons than for their daughters.

Findings regarding effects of course work are somewhat perplexing, but the dominant pattern is that academic courses increase test scores and career expectations; whereas, vocational courses tend to do the reverse. Academic courses also tend to improve deportment in school, though foreign language taken by males operates in perverse fashion. Effects of business and office courses exhibit interesting interaction by gender. They increase verbal test score and work values for both genders, increase educational and occupational expectations of males, but deflate educational expectations of females. Thus they tend to reinforce sex sterotyping of jobs.

The policy implications of the results reported here are not as crisp as one might like, but the findings to suggest that serious reflection is in order. Although effects of tracking as a mechanism for transmitting SEB directly into academic achievement and career expectations are not as strong in the present analyses as others have claimed, the eff cts that do occur suggest that tracking policy should be reexamined. What positive functions does tracking serve? As Rosenbaum (1976) argues, variables used to sort students into tracks are not stable in early high school. Therefore, mistakes are inevitable. These mistakes likely are affected by SEB in ways unfavorable to low status youth.

At first glance the findings regarding effects of course work suggest that more academic courses and fewer vocational courses should be offered. but such a conclusion would be too hasty. Some vocational courses taken by some students raise test scores, career plans, and work values--all desirable consequences, ceteris paribus. Vocational courses offer content that is important to later life, such as clerical skills, skills working with machinery, and knowledge of the world of work. These benefits are not likely to be acquired if all courses taken are academic. Consequently, it is concluded that careful examination of the function and content of vocational education courses is needed. We know that such courses at their best yield important benefits. But the evidence presented here also suggests that illconsidered proliferation of vocational courses may have unwanted consequences. The challenge, therefore, is to determine which vocational courses under what circumstances yield outcomes in line with educational and social goals.

The findings regarding effects of family income on educationale expectation are serendipitous, since the focus of this paper is on other matters. Yet they are important. The strong and increasing direct effect of income on membership in the academic rack, irrespective of past achievement, indicate the importance of public financial resources to aid youth from low income families to gain access to college education. Financial aid to college students is important both from an equity standpoint and from the standpoint of making optimum use of our nation's human resources.

CHAPTER 8

REVIEW AND REFLECTIONS

This report undertakes a sequence of statistical analyses designed to provide information pertinent to understanding processes related to the quality of education in the United States. Ten schooling outcomes are studied as dependent variables:

- Verbal test score
- Mathematics test score
- Science test score
- Civics test score
- Educational expectation
- Occupational expectation
- Deportment in school
- Self-esteem
- Locus of control (internal-external)
- Work values

These outcomes were selected for their relevance to preparation of youth for employment after leaving school.

The analyses are conducted with the base year and first follow-up data collected from the younger cohort (1980 sophomores) of the High School and Beyond (HSB) data. The analyses are motivated by explicit models of change over time expressed by differential equations. In all cases, the differential equation models lead to statistical analyses in which the first follow-up values of the outcomes are dependent variables and their lagged (base year) values are included as controls. Thus, many of the difficulties associated with cross-sectional data used in past research are sidestepped. In particular, the work reported here is not nearly as vulnerable to the charge that differences between schools in student outcomes are due to student differences when they entered a school as is research based on cross-sectional differences among schools.

Four studies are reported in the preceding chapters. The first examines overall school effects on the 10 outcomes using dummy variables for each of the over 1,000 (save one) schools in the sample. Partial correlations reported in this work are corrected for loss of degrees of freedom. The second study identifies specific school characteristics that account for overall school effects. The third study investigates effects of dropping out of school on verbal and math test scores. The fourth study examines effects of curriculum track (academic and vocational) and coursework on the 10 outcome variables.

Major Findings

Findings from the study of overall school effects and the study of effects of specific school characteristics may be summarized conveniently as a unit. The main findings are as follows:

- Overall between-school effects are not as strong as combined effects of socioeconomic background, but they are, nevertheless, quite strong for most of the outcomes.

- The combined effects of 40 specific school characteristics are nearly as strong as the overall effects of between-school differences based on dummy regression analysis.

- School sector (private-public) does not exercise strong or even statistically significant effects on the 10 outcomes studied here.

- School desegregation exercises small or no effects on the 10 outcomes.

- Demographic composition of the students in a school has relatively strong effects on test scores and career expectations.

- Student context (e.g., proportion of dropouts, proportion of graduates attending college, proportion in the vocational track) exercises comparatively strong effects on test scores and career expectations.

- School resources and facilities have negligible effects on the 10 outcomes.

- Teacher and staff characteristics such as training, experience and salary do not have strong effects on the 10 outcomes. One exception appears to be an effect of teacher experience on improving school deportment.

- Curriculum variables such as the number of math and science courses have relatively strong effects on academic growth.

- Pedagogy variables such as ability grouping do not have strong effects on any of the 10 outcomes.

- School aggregate of time per year spent in class has negligible effects on the ten outcomes.

- Small regional differences occur in all 10 outcome variables.

- Indirect evidence based on reasoning about processes over time suggests that the influence of socioeconomic background on the 10 outcomes declines over time while that of schooling increases.

- The test scores and educational expectation are more strongly affected by SES and by schooling than the other outcomes.

There are three reasons why these results are important. First, they establish that the school attended does make a difference in test score performance and career expectations of youth. It is therefore difficult to maintain that society can be indifferent to quality distinctions among schools and to mechanisms by which youth are selected into different schools. Second, it is found that one of the primary policy instruments of school officials--curriculum--does in fact influence schooling outcomes. Third, they refute some strongly held beliefs that, if acted on, would have far-reaching consequences. These beliefs include: (1) private schools are more effective than public schools, (2) school desegregation is extremely disruptive to educational processes, and (3) substantial increments in learning could be effected by increasing the length of the school day and school year.

In a follow-up stage of the analyses, effects of specific school characteristics are reexamined under the hypothesis that the 10 outcome variables affect each other. This hypothesis leads to including controls in each equation for lagged value of all 10 outcomes (plus 3 other predetermined variables), rather than just the lagged value of the dependent variable in a given equation. The main conclusions of the original analyses remain essentially intact when the additional controls are included.

The study of the effects of dropping out of school on verbal and math test provides a much better test of the impact of exposure to school on learning than do investigations of between-school differences.* In more generic terms. this point has been repeated numerous times in the literature, but few empirical tests have been conducted. Presence of test score data both before and after students dropped out permits a unique study of the effects of schooling. The primary findings are these:

- Dropping out of school has a strong negative impact on verbal and math skills that are not necessarily explicit parts of course syllabi.
- An interaction model postulating that learning is the product of "readiness" and exposure shows substantially larger effects of dropping out than does the standard linear model.
- Effects of dropping out are more injurious to blacks than to whites.

These results are noteworthy because they help dispel the pessimistic view that schooling is ineffective and because they point to a need for reconsidering the indiscriminant use of a linear specification in studying schooling effectiveness.

The study of curriculum and course work effects is conducted in three stages. In the first stage, self-reported curriculum track is used to construct a dummy variable indicating membership in the academic (or college preparatory) track. The track variable is entered on the right of equations including controls for background and lagged dependent variable. In stage two, controls for a large number of lagged endogenous variables are added to the equations.

---

*Study of between-school differences is nevertheless important for reasons illustrated in chapters 4 and 5 of this report.

In the third stage, course work variables are added to the equations of stage two. Additionally, equations estimating effects of status background on track membership are examined. The main findings are as follows:

- With controls for exogenous background variables and lagged dependent variable, effect estimates of track on all 10 outcomes except work values are strong.

- When controls for the full complement of lagged endogenous variables are added to the equations in stage one, large reductions in the estimates of the effects of track are observed. Many of the formerly significant coefficients are reduced to nonsignificance.

- Even with controls for the full set of lagged endogenous variables, some important effects of track membership remain. Positive effects of membership in the academic track are relatively strong on educational expectation and math test score for both males and females.

- A portion of the total effects of track membership on the outcomes where significant coefficients appear is mediated by the pattern of course work taken in the last two years of high school. But the main pattern of effects observed prior to including controls for course work persist after the controls are added. The most important exception is that the total effect of track on educational expectations of females is largely mediated by course work.

- Total effects of family background on track membership are uniformly large, but race and ethnicity effects are absent. Much of the total effects of background are mediated by academic achievement, career expectations, and other attitudes. The most important components of the mediator variables consist of career expectations and other attitudes rather than academic achievement.

- Total effects of family income on membership in the academic track more than doubles during the last two years of high school.

- The effects of family income on membership in the academic track are larger for females than for males.

- Vocational courses tend to deflate test scores and career expectations, but not always. Business and office courses increase verbal test scores of females, increase work values of both sexes, increase educational and occupational expectations of males and decrease educational expectations of females.

- This pattern of effects tends to reinforce sex stereotyping of preparation for employment.

These findings are important for several reasons. First, they demonstrate the importance of including controls for many endogenous variables when estimating effects of curriculum track. Second, they suggest that track may be one mechanism by which socioeconomic background is transmitted between generations--though the role of track in this regard is not exceptionally strong. Third, they show the key role of family income in the last two years of high school in determining whether a youth reports himself or herself to be in the academic curriculum track. Fourth, they reveal how patterns of sex stereotyping of preparation for employment are reinforced in high school.

Use of Change Models

Expressing basic theory of educational processes with explicit models of change over time is a useful device. First, it has served as a guide for the statistical analyses in this report. As a consequence, the statistical work includes controls for lagged values of dependent variables, but contemporaneous values are not included in the specifications *

Second, the change model has aided in the interpretation of statistical findings. The most important example is the interpretation of cross-sectional and longitudinal equations. Under specified assumptions, the cross-sectional regression coefficients can be interpreted as accumulated effects over one's lifetime and the accumulated longitudinal coefficients index effects over the time period between measurements.

Third, the explicit change model renders assumptions of particular statistical analyses explicit. The main examples of this are comprised of assumptions that both exogenous variables and effects are constant over time.

Finally, a somewhat more diffuse benefit of working with an explicit model of change is that it forces the researcher to conceptualize theory in dynamic terms. The habit of thinking about dynamic processes and translating them into explicit models should, in the long run, improve the quality of theory.

Next Steps

There are a number of additional analyses that should shed additional light on the schooling process and that can be carried out with existing HSB data. First, the model of school characteristics effects has not exhausted the array of school variables that one might hypothesize as important in education. Decomposition of some of the indexes such as principals' judgments about school problems and youth's quality judgments may uncover some interesting patterns. Also, that types of school characteristics such as facilities, teacher pay rate, or training have no effects on learning is perplexing. Ostensibly, better facilities, better paid teachers, and better trained teachers ought to improve learning. Why don't they? Perhaps they do under

*This is not to say that a differential equation model could never generate such a statistical specification. If it did, however, interpretation of the coefficients would be substantially different from interpretations generally offered in the literature.

certain circumstances. Perhaps, highly paid, well-trained teachers with good facilities improve learning, but any one of these factors alone does not. Interaction hypotheses can be devised to test this type of speculation.

As a preliminary step in extending the study of between-school differences, the dummy regression analyses reported in chapter 4 should be extended to permit regression slopes (as well as intercepts) to vary among schools. The general postulate that learning is the product of readiness and exposure leads directly to this type of extension of the study of overall school effects. If exposure varies across schools and the usual array of personal characteristics, SES, and lagged test scores influence readiness, then the interaction by school is indicated. Such analysis would consume an enormous number of degrees of freedom in the HSB sample, so careful use of statistical tests and correction of R-squares for loss of degrees of freedom would be necessary. If the basic hypothesis is correct--that learning is the product of exposure and readiness--and exposure (opportunity) differs among schools, the effort would be worthwhile.

The study of dropout effects and curriculum track and course work effects might usefully be combined into a single conceptual framework. Curriculum track and course work certainly are important indicators of exposure for those who do not drop out of school. Separate regressions carried out within track, hours of course work, and dropout status would expand the interaction model in a sensible way. Further, since nonacademic track students are more likely to drop out of school than academic track students, study of effects of track should be carried out under control for dropout status. The study of dropouts should be extended to include more dependent variables. The present report includes only verbal and math test scores.

The study of school-level effects and effects of processes within schools should be integrated into a single framework. The simplest extension would be to include school characteristics and within-school processes in the same regression model. While this strategy might yield some useful clues, the question of integrating levels of analysis deserves careful thought. Chapter 5 develops some elementary algebraic relationships between individual-level and aggregate models. These relationships could serve as tools in working out a theoretical framework integrating levels of analysis. The idea that school characteristics produce within-school patterns that in turn directly influence students should serve as a starting point. Ideas of school ethos and student culture should be worked into such a theory.

The concept of curriculum track is unclear. Some school systems use formal tracks, and the track pursued by each student is recorded on the transcript. Other schools do not use formal tracks but may develop informal mechanisms that closely parallel tracking. It seems that track would correlated highly with course work--or even be defined by course work--but empirical study shows a low correlation. Campbell and his colleagues (1981) develop a typology of vocational education commitment based on the amount and timing of vocational course work taken. Such a conceptualization may be useful for determining effects of vocational course work, but it does not address issues raised by Rosenbaum (1976), Oakes (1982), and Boyer (1983) regarding informal effects of tracking.

An intriguing question raised by the finding that schools exercise effects on cognitive and noncognitive outcomes under fairly extensive control for socioeconomic background is: What effects does socioeconomic background have on the quality of school a youth attends? A closely related question then is: Do variations in school quality serve as one of the mechanisms by which SES is transmitted between generations?

The deportment index used in this report contains six components--school absenteeism, tardiness, cutting classes, discipline problems in school, suspension from school, and being in trouble with the law. The index was used to simplify a complex undertaking, but it is clear that the components are heterogenous and deserve separate attention. In particular, the effects of cutting class and skipping school should be integrated into a model containing the length of the school day and year in order to determine individual-level effects of length of time in school. A study of factors that influence the individual components of the deportment index using the longitudinal HSB data has strong potential for extending the work of Thomas DiPrete (1981) that relies on the base year HSB data.

The persistent regional effects--in spite of extensive controls for socioeconomic background and school characteristics--on the 10 outcome variables used in this report deserves further attention. A number of angles should be pursued. One strategy is to investigate whether more complete controls for socioeconomic background would reduce the coefficients on region. Youth reports of parental status characteristics are not very reliable (Kerckhoff, Mason, and Poss 1973). Parental reports from the HSB parent file could be substituted, but the loss in sample size would be dramatic. A more promising strategy is to include region in equations that expand on the product model of learning. It is likely that with a more nearly accurate specification of the learning process region effects would be reduced. Another approach is to examine school characteristics that correlate with region and the 10 outcomes and add these to the specifications used in chapter 5. The possibility that resource differences by region account for region effects also should be explored. The fact that school-level differences in resources do not have much effect on the outcomes is not certain evidence that resources aggregated to the region level would not affect the outcomes. If such effects were found, however, careful consideration of appropriate interpretation would be required. State data describing educational policies could be used to predict the schooling outcomes. It is possible that region effects are due to variations among regions in state educational policies.

In chapter 5, it is found that the number of math and science courses offered at a school has positive effects on test scores. In chapter 7, it is reported that the number of courses in various categorical groupings taken by individuals affect test scores and career expectations. A study integrating these findings would be useful. The most obvious hypothesis is that course work taken by individuals mediates the effects of school-level course offerings. But confirming this hypothesis in empirical work is by no means a foregone conclusion. If it were not confirmed, some inventive detective work would be in order to discover the mechanisms by which school course offerings do in fact operate.

Many of the analyses reported here should be repeated within race and gender categories. In particular, the effects of school characteristics such as racial composition and curriculum should be compared by race.

Policy Implications

This section reviews some of the most salient policy implications of the findings of this report. In reviewing these inplications, the reader should recall the necessarily tentative nature of the findings on which they are based. Many of the difficulties with drawing firm conclusions from the data analyses reported here have been detailed in previous chapters, they will not be repeated here. In this section, the findings are taken at face value and their implications set forth. They should be interpreted as one additional set of observations to be used in the complex process of formulating educational policy. Additionally, even assuming that every finding reported herein holds up under repeated scrutiny, implementing their policy implications depends on many considerations that lie outside the scope of a focused research report such as the present one. Since this report is not a policy document, full discussion of the many factors that must be considered in a policy context is not given.

One of the most encouraging findings of this report is that school curriculum has the expected effects on learning. More academic course offerings raise test scores and educational expectations. Additionally, individuals who take academic courses raise their test scores more rapidly than those who don't. Consequently, assuming that an important goal of education is to improve academic achievcement as reflected in test scores, two implication of these findings are that--

- consideration should be given to increasing the number of academic courses offered in U.S. high schools, and
- students should be encouraged (required) to take academic courses.

This policy implication is in line with recent commission reports, such as the National Commission on Excellence, and agrees with recent curriculum shifts in public high schools in the United States.

At the same time, we have not found strong effects of the length of the school day and school year on any of the 10 outcomes studied in this report. Since expanding the time in school is one of the most expensive educational reforms--

- the the school day and school year probably should not be lengthened unless further evidence gives strong reason to do so.

Recent plans to encourage expansion of private schools (such as vouchers) also seem ill advised based on the evidence in this report. Sector, at best, has very small effects on the 10 outcomes studied here. In fact "other private schools" tend to reduce the "work ethic." Major expansion of the role of private schools in the United States has far-reaching implications and probably could not be reversed easily. Therefore--

• the role of private schools in U.S. education should remain relatively stable unless much stronger evidence of the advantages of private schooling than has been mustered to date is forthcoming.

The findings regarding the effects of dropping out of school on verbal and math test scores are clear--dropping out depresses them; this effect is more severe for blacks. These findings reinforce the view that--

• steps should be taken to discourage youth from leaving high school before they finish. Efforts to discourage blacks from leaving school early should be especially intense.

The findings regarding effects of curriculum tracking and course work related to track suggest that tracking may serve an undesirable selection function. Although the effects of track are not large they are large enough that a review of both positive and negative functions should be undertaken. In the course of that review,

• consideration should be given to abandoning the tracking system in high schools.

It must be recognized, of course, that abandoning the tracking system probably would not be easy to accomplish. Even if formal assignment to tracks were discontinued, many informal mechanisms for retaining the functions of tracking would persist. Students still would like to take, or be routed into, classes in manner reflecting the formal tracking system that had just been repealed. Also, ability grouping of academic classes can easily be used to achieve results similar to those of curriculum tracking.

It must be emphasized that abandoning tracking does not mean that vocational courses should be discontinued or even reduced. Youth must be prepared for the world of work, and to the extent that vocational courses do so, they are important. Courses in clerical skills appear particularly important. They not only give women an advantage in the labor market, but they also tend to improve their verbal skills.

Synopsis

The material in this report is encouraging. It shows that schools are effective in imparting academic knowledge to our Nation's youth. It shows that a key policy instrument in education--curriculum--has important effects on cognitive and noncognitive outcomes. A number of important policy implications have been drawn from the analyses, but they are by no means definitive. The very nature of policy requires that it be formulated on the basis of the balance of evidence. The business of accumulating relevant evidence is a relentless task. Many important next steps have been outlined here; pursuit of some of these ideas could pay important dividends.

REFERENCES

Aigner, James S. "A Comment on Problems in Making Inferences from the Coleman Report." American Sociological Review 35 (April 1970): 240-252.

Alexander, Karl L.; Cook, Martha A.; and McDill, Edward L. "Curriculum Tracking and Educational Stratification: Some Further Evidence." American Sociological Review 41 (1976): 144-152.

Alexander, Karl L.; Eckland, Bruce K.; and Griffin, Larry J. "The Wisconsin Model of Socioeconomic Achievement: A Replication." American Journal of Sociology 81 (1975): 324-343.

Alexander, Karl L.; McPartland, James M.; and Cook, Martha A. "Using Standardized Test Performance in School Effects Research." In Vol. 2 of Research in Sociology of Education and Socialization: Research on Educational Organizations, edited by Alan C. Kerckhoff, pp. 1-34, 1981.

Alexander, Karl L., and McDill, Edward L. "Selection and Allocation within Schools: Some Causes and Consequences of Curriculum Placement." American Sociological Review 41 (1976): 963-980.

Alexander, Karl L., and Pallas, Aaron M. "Private Schools and Public Policy: New Evidence on Cognitive Achievement in Public and Private Schools." Sociology of Education 56 (October 1983): 170-182.

Arminger, Gerhard. "Estimation of Parameters of Linear Stochastic Differential Equations and Their Covariances from Panel Data." Paper presented at the Annual Meetings of the American Sociological Association, 1983.

Armor, David J. "School and Family Effects on Black and White Achievement: A Reexamination of the USOE Data." In On Equality of Educational Opportunity, edited by Frederick Mosteller and Daniel P. Moynihan, pp. 168-229. New York: Random House, 1972.

Averch, Harvey A.; Carroll, Stephen J.; Donaldson, theodore S.; Kiesling, Herbert J.; and Pincus, John. How Effective Is Schooling? A Critical Review and Synthesis of Research Findings. Santa Monica, CA: Rand, 1972.

Becker, Gary S. Human Capital. New York: Columbia University Press, 1975.

Bidwell, Charles E., and Kasarda, John D. "Conceptualizing and Measuring the Effects of School and Schooling." American Journal of Education 88 (1980): 401-430.

Bidwell, Charles E., and Kasarda, John D. "School District Organization and Student Achievement." American Sociological Review 40 (February 1975): 55-70.

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

Boardman, Anthony E., and Murnane, Richard J. "Using Panel Data to Improve Estimates of the Determinants of Educational Achievement." Sociology of Education 52 (April 1979): 113-121.

Bowles, Samuel, and Levin, Henry M. "More on Multicollinearity and the Effectiveness of Schools." Journal of Human Resources 3 (Summer 1968): 393-400.

Boyer, Ernest L. High School: A Report on Secondary Education in America. New York: Harper & Row, Publishers, 1982.

Bridge, R. Gary; Judd, Charles M.; and Moock, Peter R. The Determinants of Educational Outcomes. Cambridge, MA: Ballinger Publishing Co., 1979.

Brookover, W. B., and Lezotte, L. Schools Can Make a Difference. East Lansing: College of Urban Development, Michigan State University, 1977.

Brookover, Wilbur; Beady, Charles; Flood, Patricia; Schweitzer, John; and Wisenbaker, Joe. School Social System and Student Achievement: Schools Can Make a Difference. New York: Praeger Publishers, 1979.

Cain, Glen G., and Goldberger, Arthur S. "Public and Private Schools Revisited." Sociology of Education 56 (October 1983): 208-218.

Cain, Glen G., and Watts, Harold W. "The Controversy about The Coleman Report: Comment." Journal of Human Resources 3 (Summer 1968): 389-392.

__________. "Problems in Making Policy Inferences from the Coleman Report." American Sociological Review 35 (April 1970): 228-242.

Campbell, Paul B.; Orth, Mollie N.; and Seitz, Patricia. Patterns of Participation in Secondary Vocational Education. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1981.

Campbell, Richard T. "Status Attainment Research: End of the Beginning or Beginning of the End?" Sociology of Education 56 (January 1983): 47-62.

Center for Public Resources. Basic Skills in the U.S. Work Force: The Contrasting Perceptions of Business, Labor and Public Education. NY: Center for Public Resources, 1982.

Clark, B. "The 'Cooling-Out' Function in Higher Education." In Education, Economy, and Society, edited by A. H. Halsey et al., pp. 513-526. New York: Free Press, (1960).

Clark, D. L.; Lotto, L. S.; and McCarthy, M. M. "Factors Associated with Success in Urban Elementary Schools." Phi Delta Kappan 61 (1980): 467-470.

Cohen, Michael. "Effective Schools: Accumulating Research Findings." American Education (January-February 1982).

Cohen, Michael. "Effective Schools: What the Research Says." Today's Education. (April-May 1981): 46G-50G.

Coleman, J. S.; Campbell, E. Q.; Hobson, C. J.; McPartland, J.; Mood, A. M.; Weinfeld, F. D.; and York, R. L. Equality of Educational Opportunity. Washington, DC: Government Printing Office, 1966.

Coleman, James S. The Adolescent Society: The Social Life of the Teenager and Its Impact on Education. New York: Free Press, 1961.

_______________. "The Evaluation of Equality of Education Opportunity." In On Euality of Educational Opportunity, edited by Frederick Mosteller and Daniel P. Moynihan, pp. 146- 7. New York: Random House, 1972.

_______________. "The Mathematical Study of Change." In Methodology in Social Research, edited by Herbert M. Blalock and Ann B. Blalock, pp. New York: McGraw-Hill, 1968.

_______________. "Reply to Cain and Watts." American Sociological Review 35 (April 1970): 242-249.

Coleman, James S.; Hoffer, Thomas; and Kilgore, Sally. High School Achievement. New York: Basic Books, 1982.

DiPrete, Thomas A. Discipline, Order and Student Behavior in American High Schools. Prepared for the National Center for Educationa Statistics under contract OE-300-78-0208 with the U.S. Department of Education. Washington, DC: National Opinion Research Center, November 1981.

Doreian, Patrick, and Hummon, Norman P. Modeling Social Process. New York: Elsevier, 1976.

___________________________________. "Models of Stratification Processes." Quality and Quantity 8 (1974): 327-345.

Duncan, Otis D.; Featherman, David L.; and Duncan, Beverly. Socioeconomic Background and Achievement. New York: Seminar Press, 1972.

Edmonds, Ronald R. "Some Schools Work and More Can." Social Policy 9 (March-April 1979): 28-32.

Education Commission of the States. Action for Excellence: A Plan for Improving Education. Denver, CO: Distribution Center, Education Commission of The States, 1983.

Etzioni, Amitai. An Immodest Agenda: Rebuilding America before the 21st Century. New York: McGraw-Hill, 1983.

Etzioni, Amitai. "Schools: Educational Experiences First--Part I." American Education 18 (November 1982): 6-10.

Featherman, David L., and Carter, T. Michael. "Discontinuities in Schooling and the Socioeconomic Life Cycle." In Schooling and Achievement in American Society, edited by William H. Sewell, Robert M. Hauser, and David L. Featherman, pp. 133-160. New York: Academic Press, 1976.

Featherman, David L., and Hauser, Robert M. Opportunity and Change. New York: Academic Press, 1978.

Feldman, Kenneth A., and Weiler, John. "Changes in Initial Differences among Major-Field Groups: An Exploration of the 'Accentuation Effect'." In Schooling and Achievement in American Society, edited by William H. Sewell, Robert M. Hauser, and David L. Featherman, pp. 373-407. New York: Academic Press, 1976.

Frankel, Martin R.; Kohnke, Luane; Buonanno, David; and Tourangeau, Roger. Sample Design Report: A Report to the National Center for Education Statistics under Contract No. 300-78-0208 by the National Opinion Research Center. Chicago: National Opinion Research Center, 1981.

Freeman, Richard B. The Overeducated American. New York: Academic Press, 1976.

Freeman, Richard B., and Wise, David A. The Youth Labor Market Problem: Its Nature, Causes, and Consequences. Chicago: The University of Chicago Press, 1982.

Gray, G.; Smith, A.; and Rutter, M. "School Attendance and the First Year of Employment." In Out of School, edited by L. Hesov and Ian Berg. New York: John Wiley & Sons, 1980.

Gilbert, John P. and Mosteller, Frederick. "The Urgent Need for Experimentation." In On Equality of Educational Opportunity, edited by Frederick Mosteller and Daniel P. Moynihan, pp. 371-383. New York: Random House, 1972.

Glass, Gene V.; Cahen, Leonard S.; Smith, Mary Lee; and Filby, Nikola N. School Class Size. Beverly Hills, CA: Sage Publications, 1982.

Goldberger, Arthur S., and Cain, Glen G. "The Causal Analysis of Cognitive Outcomes in the Coleman, Hoffer, and Kilgore Report." Sociology of Education 55 (1982): 103-122.

Goodlad, John I. A Place Called School: Prospects for the Future. New York: McGraw-Hill, 1983.

Gross, Neal, and Herriott, Robert E. Staff Leadership in Public Schools: A Sociological Inquiry. New York: John Wiley and Sons, 1965.

Hannan, Michael T., and Young, Alice A. "Estimation in Panel Models: Results on Pooling Cross-Sections and Time Series." In Sociological Methodology 1977, edited by David R. Heise, pp. 52-83. San Francisco, CA: Jossey-Bass, 1977.

Hanushek, Eric A., and Kain, John F. "On the Value of Equality of Educational Opportunity as a Guide to Public Policy." In On Equality of Educational Opportunity, edited by Frederick Mosteller and Daniel P. Moynihan, pp. 116-145. New York: Random House, 1972.

Hauser, Robert M. "A Comment on A Reconceptualization on School Effects." In Sociology of Education 51, edited by Aage B. Sorensen, and Maureen T. Hallinan, pp. 68-73, January 1978.

Hauser, Robert M. "Context and Consex: A Cautionary Tale." American Journal of Sociology 75 (1970): 645-664.

__________. "Contextual Analysis Revisited." Sociological Methods and Research 2 (1974): 365-375.

__________. Socioeconomic Background and Educational Performance. Washington, DC: American Sociological Association, 1971.

Hauser, Robert M., and Featherman, David L. The Process of Stratification: Trends and Analyses. New York: Academic Press, 1977.

Hauser, Robert M.; Sewell, William H.; and Alwin, Duane F. "High School Effects on Achievement." In Schooling and Achievement in American Society edited by William H. Sewell, Robert M. Hauser, and David L. Featherman, pp. 309-342. New York: Academic Press, 1976.

Hauser, Robert M.; Tsai, Shu-Ling; and Sewell, William H. "A Model of Stratification with Response Error in Social and Psychological Variables." Sociology of Education 56 (January 1983): 20-46.

Hertel, Bradley R. "Minimizing Error Variance Introduced by Missing Data Routines in Survey Analysis." Sociological Methods and Research 4 (May 1976): 459-474.

Heyns, Barbara. "Social Selection and Stratification within Schools." American Journal of Sociology 79 (1974): 1434-1451

__________. Summer Learning and the Effects of Schooling. New York: Academic Press, 1978.

Heyns, Barbara, and Hilton, Thomas L. "The Cognitive Tests for High School and Beyond: An Assessment." Sociology of Education 55 (1982): 89-102.

Hollenbeck, Kevin, and Smith, Bruce. "Selecting Young Workers: The Influence of Applicants' Education and Skills on Employability Assessments by Employers." Columbus: The National Center for Research in Vocational Education, The Ohio State University, January 1984.

Hotchkiss, Lawrence. Differential Equation Methodology Applied to Career Decisions and Status Attainment Processes: Conceptualization and Calculation. Columbus: The Ohio State University, The National Center for Research in Vocational Education, 1979.

Hotchkiss, Lawrence; Bishop, John H.; and Gardner, John. Effects of Individual and School Characteristics on Part-Time Work of High School Seniors. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

Hotchkiss, Lawrence, and Chiteji, Lisa. The Dynamics of Career Expectations of Youth: A Theoretical Formulation and Empirical Report Based on a Longitudinal Study. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1981.

Jencks, Christopher; Crouse, James; and Mueser, Peter. "The Wisconsin Model of Status Attainment: A National Replication with Improved Measures of Ability and Aspiration." Sociology of Education 56 (January 1983): 3-19.

Jencks, Christopher et al. Who Gets Ahead? New York: Basic Books, 1979.

Jencks, Christopher S. and Brown, Marsha, D. "Effects of High Schools on Their Students." Harvard Educational Review 45 (August, 1975): 273-324.

Jencks, Christopher S.; Smith, M.; Acland, H.; Bane, M. J.; Cohen, D.; Gintis, H.; Heyns, B.; and Michelson, S. Inequality: A Reassessment of the Effect of Family and Schooling in America. New York: Basic Books, 1972.

Jones, Calvin; Clarke, Miriam; Mooney, Geraldine; McWilliams, Harold; Crawford, Ioanna; Stephenson, Bruce; and Tourangeau, Roger. High School and Beyond 1980 Sophomore Cohort First Follow-up (1982). Chicago: National Opinion Research Center, 1983.

Judge, George G.; Griffiths, William E.; Hill, R. Carter; and Lee, Tsoung-Chao. The Theory and Practice of Econometrics. New York: John Wiley and Sons, 1980.

Kang, Suk and Bishop, John. "The Effect of Curriculum on Labor Market Success Immediately After High School." Paper read at the 1984 annual meeting of the American Educational Research Association. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

Karweit, Nancy. "A Reanalysis of the Effect of Quantity of Schooling on Achievement." Sociology of Education 49 (July 1976): 236-246.

Karweit, Nancy L. "Time in School." In Vol. 2 of Research in Sociology of Education and Sociolization: Research on Educational Organizations, edited by Alan C. Kerckhoff, pp. 77-110, 1981.

Kerckhoff, Alan C.; Mason, William M.; and Poss, Sharon S. "On the Accuracy of Children's Reports of Family Status." Sociology of Education 46 (1973): 219-247.

Kilgore, Sally B. "Statistical Evidence, Selectivity Effects and Program Placement: Response to Alexander and Pallas." Sociology of Education 56 (October 1983): 182-186.

Mackenzie, Donald E. "Research for School Improvement: An Appraisal of Some Recent Trends." Educational Researcher 12 (April 1983): 5-17.

Madaus, George F.; Airasian, Peter W.; and Kellaghan, Thomas. School Effectiveness: A Reassessment of the Evidence. New York: McGraw-Hill Book Co., 1980.

Mayeske, G. W.; and Beaton, A. E., Jr. Special Studies of Our Nation's Students. Washington, DC: Office of Education, U.S. Dept. of Health, Education, and Welfare, 19.5.

Mayeske, G. W.; Cohen, W. M.; Wisler, C. E.; Okada, T.; and Beaton, A. E., Jr. A Study of Our Nation's Schools. Washington, DC: Office of Education, U.S. Dept. of Health, Education, and Welfare, 1972.

Mayeske, G. W.; Okada, T.; Beston, A. E., Jr.; Cohen, W. M.; and Wisler, C. E. A Study of Achievement of Our Nation's Students. Washington, DC: Office of Education, U.S. Dept. of Health, Education, and Welfare, 1973.

McDill, Edward L., and Rigsby, Leo C. Structure and Process in Secondary Schools: The Academic Impact of Educational Climates. Baltimore, MD: The Johns Hopkins University Press, 1973.

McPartland, James M., and Karweit, Nancy. "Research on Educational Effects." In Educational Environments and Effects, edited by Herbert J. Walberg. Berkeley: McCutchan Publishing Co., 1979.

Meyer, Robert. "The Labor Market Effects of Vocational Education." Urban Institute and Harvard University, 1981b.

____________. "Vocational Education: How Should It be Measured?" Urban Institute and Harvard University, 1981a.

____________. "An Economic Analysis of High School Vocational Education: The Labor Market Effects of Vocational Education." Washington, DC: The Urban Institute, 1981.

Mortimer, Jeylan T., and Finch, Michael P. "The Effects of Part-Time Work on Adolescent Self-Concept and Achievement." In Becoming A Worker, edited by Kathryn Borman and Jane Reisman. Norwood, NJ: Ablex, forthcoming.

Murnane, Richard J. The Impact of School Resources on the Learning of Inner City Children. Cambridge, MA: Ballinger Publishing Co., 1975.

Namboodiri, N. Krishnan; Carter, Lewis F.; and Blalock, Hubert M. Applied Multivariate Analysis and Experimental Designs. New York: McGraw-Hill, 1975.

National Academy of Science. Education for Tomorrow's Jobs. Arlington, VA: American Vocational Association, 198_.

National Commission on Excellence in Education. "A Nation at Risk: The Imperative for Educational Reform." Reprinted in The Chronicle of Higher Education 26 (4 May 1983): 11-16.

Nielsen, Francois and Rosenfeld, Rachel A. "Substantive Interpretations of Differential Equation Models." American Sociological Review 46 (1981): 159-174.

Nucci, Larry P., and Walberg, Herbert J. "Psychological models of Educational Growth." In Psychology and Education: The State of the Union, edited by Frank H. Farley and Neal J. Gordon, pp. 201-236. Berkeley, CA: McCutchan Publishing, 1981.

Oakes, Jeannie. "The Reproduction of Inequality: The Content of Secondary School Tracking." The Urban Review 14 (1982): 107-120.

Peterson, Paul E. "Did the Education Commissions Say Anything?" The Brookings Review (Winter 1983): 3-11.

Purkey, Stuart C., and Smith, Marshall S. "Effective Schools: A Review." Elementary School Journal 83 (1983): 427-452.

Raelin, Joseph A. Building A Career: The Effect of Initial Job Experience and Related Work Attitudes on Later Employment. Kalamazoo, MI: W. C. Upjohn Institute for Employment Research, 1980.

Rao, C. Radhakrishna. Linear Statistical Inference and Its Applications, Second Edition. New York: John Wiley and Sons, 1973.

Rehberg, Richard A., and Rosenthal, Evelyn R. Class and Merit in the American High School: An Assessment of the Revisionist and Meritocratic Arguments. New York: Longman, 1978.

Robinson, william S. "Ecological Correlations and the Behavior of Individuals." American Sociological Review 15 (1950): 351-357.

Rosenbaum, James E. Making Inequality: The hidden Curriculum of High School Tracking. New York: John Wiley and Sons, 1976.

________________. "Track Misperceptions and Frustrated College Plans: An Analysis of the Effects of Tracks and Track Perceptions in the National Longitudinal Survey." Sociology of Education, 53, no. 2 (April 1980): 74-88.

Rumberger, Russell W. Overeducation in the U.S. Labor Market. New York: Praeger Publishers, 1981.

Rumberger, Russell W. and Daymont, Thomas N. The Economic Value of Academic and Vocational Training Acquired in High School. Stanford, CA: Institute for Research on Educational Finance and Governance, Stanford University, September 1982.

Rutter, Michael; Maughan, Barbara; Mortimore, Peter; Ouston, Janet; with Smith, Alan. Fifteen Thousand Hours. Cambridge, MA: Harvard University Press, 1979.

Sewell, William H.; Haller, Archibald O.; and Ohlendorf, George. "The Educational and Early Occupational Attainment Process: Replications and Revisions." American Sociological Review 35 (1970): 1014-1027.

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

Sherman, Susan W., ed. Education for Tomorrow's Jobs. Washington, DC: National Academy Press, 1983.

Smith, Marshall S. "Equality of Educational Opportunity: The Basic Findings Reconsidered." In On Equality of Educational Opportunity, edited by Frederick Mosteller and Daniel P. Moynihan, pp. 230-342. New York: Random House, 1972.

Sórensen, Aage B. "A Reply to Hauser." Sociology of Education 51 (July 1978): 230-233.

Sórensen, Aage B., and Hallinan, Maureen T. "A Reconceptualization of School Effects." Sociology of Education 50 (October 1977): 273-289.

Spady, William G. "The Impact of School Resources on Students." In Schooling and Achievement in American Society edited by William H. Sewell, Robert M. Hauser, and David L. Featherman, pp. 185-224. New York: Academic Press, 1976.

Summers, A. A., and Wolfe, B. L. "Do Schools Make a Difference?" American Economic Review 67 (1977): 639-652.

Walberg, Herbert J., ed. Educational Environments and Effects. Berkeley, CA: McCutchan Publishing, 1979.

Walberg, Herbert J. "A Psychological Theory of Educational Productivity." In Psychology and Education: The State of the Union, edited by Frank H. Farley and Neal J. Gordon, pp. 81-108. Berkeley, CA: McCutchan Publishing, 1981.

Walling, Derald; Hotchkiss, H. Lawrence; Curry, Evans W. "Power Models and Error Terms." Sociological Methods and Research 13 (August 1984): 121-126.

Wiley, David E. "Another Hour, Another Day: Quantity of Schooling, a Potent Path for Policy." In Schooling and Achievement in American Society edited by William H. Sewell, Robert M. Hauser, and David L. Featherman, pp. 225-266. New York: Academic Press, 1976.

Wiley, David E., and Harnischfeger, Annagret. "Explosion of a Myth: Quantity of Schooling and Exposure to Instruction." Report no. 8 Studies of Educative Process. Chicago: University of Chicago, 1974.