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ABSTRACT

This report contains four studies related to preparation of youth for employment after leaving school. The first study, "Learning as a Product of Exposure and Readiness" (Hotchkiss), examined the effects of curriculum on the learning of basic skills using an interaction model. The data collected revealed statistically significant interactions among indicators of learning readiness and indicators of exposure, but the patterns of interaction did not conform to those predicted by the theoretical model. The second study, "Supply and Demand Effects on Part-Time Work of High School Students" (Hotchkiss), investigated the potential effects of a number of work variables on four work outcomes during high school: hours worked per week, wage, labor force participation, and unemployment. It was found that wage is not the primary determinant of labor supply; rather, a set of attitudes used to reflect nonmonetary rewards of work influence hours and labor force participation. The third study, "Impact of Curriculum on the Noncollege-bound Youths' Labor Market Outcomes" (Kang, Bishop), focused on the effects of high school curriculum and performance on the post-high school employment experience of noncollege-bound youth. Taking additional vocational courses was strongly associated with success in the labor market immediately after high school, and the total amount of academic and vocational course work was moderately associated with greater labor market success. The fourth study, "Time Profile of Youths' Labor Market Outcomes: An Analysis of High School and Beyond Data" (Kang), extended the third study by adding high school employment variables as predictors of post-high school employment. Work experience in high school, vocational education, and instruction in basic skills all improved students' post-high school earnings. A five-page reference list concludes the document. (MN)

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HIGH SCHOOL PREPARATION FOR EMPLOYMENT

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FOREWORD

The primary theme of this report centers on the question: How can high schools best prepare young people for productive employment after leaving school? This is a complex question, as reflected by the diversity of topics addressed in this report. Certainly we know that basic skills contribute to employability after leaving school. We also know that work attitudes and specific vocational skills exercise important influences on employability and productivity. But we do not know what the optimum mix of basic and vocational skills is nor precisely what influence work attitudes exercise. Neither do we know all that needs to be known about how to develop appropriate skill levels and work attitudes in teenage youth. This report contains four papers that contribute to the end of disentangling a complex casual network related to employability development.

Thanks are due to the authors of this report, Lawrence Hotchkiss, Suk Kang, and John Bishop. Their persistence and fortitude in producing these papers is much appreciated. Thanks also are due to Colleen Kinzelman who typed the major part of the manuscript with patience and good humor, to Vera Mueller who coordinated the production of the manuscript and assisted with its preparation, and to Cathy Jones, who assisted with typing the manuscript. Yoon-Seung Chung assisted with statistical computations for these papers; his competence and effort in this regard are appreciated.

Robert E. Taylor
Executive Director

EXECUTIVE SUMMARY

This report contains four studies related to preparation of youth for employment after leaving school. The first study examines effects of curriculum on learning of basic skills using an interaction model. The second study investigates determinants of employment outcomes during high school. The third study focuses on the effects of high school curriculum and performance on post high-school employment experience of noncollege youth. The fourth study extends the third by adding high school employment variables as predictors of post high-school employment. Detailed summaries of the 4 studies are given below.

Study 1: Interaction Model of Learning

A downward trend in high-school student scores on the SAT over the past several years (interupted in the past year) has stimulated an upsurge of interest in effective schooling practices at the high-school level. One important aspect of the call for reform is a recommendation to increase the number of academic courses required of high school students. Many states and local school districts have responded by increasing these requirements. Of course, students who take more academic courses have less time left over to take other courses. It has been speculated that not all youth benefit uniformly from taking academic courses. Some youth may benefit so little that it is not worthwhile for them to take some courses. Others may be better off taking vocational courses where they not only prepare for employment but also may improve their basic skills. To date, however, little serious investigation of these possibilities has been conducted.

A major barrier to quantitative investigation of the simple idea that not all youth derive the same benefit from the same educational experience is the nearly universal, routine reliance on the linear model. A typical linear specification of a learning function may include both measures of ability and exposure to new material. The problem with the linear specification is that it implies all students learn to the same degree the subject matter presented to them. If one believes that youth differ, for whatever reason, in their capacity to learn, then the rate at which one learns new material is higher for those with high ability to learn than for others. This argument implies that readiness or ability <u>interacts</u> with exposure to produce the learning rate.

This paper carries out a number of preliminary investigations of an interaction specification of the effects of readiness and exposure on learning rate. Two dependent variables are studied: (1) verbal test score, and (2) mathematics test score. Time-2 measures of these variables are used as the outcomes to be explained. Because of the relative difficulty of using a product model instead of a linear model, the set of independent variables is small. Indicators of exposure include amount of course work in two academic subjects (English, math), two vocational subjects (business and office, technical), and amount of homework. The data for the analyses were taken from the base-year and first follow-up surveys of the sophomore cohort in the High School and Beyond.

The data do reveal statistically significant interactions among indicators of learning readiness (or capacity to learn) and indicators of exposure. But the patterns of interaction do not conform to those predicted by the theoretical model. There are several possible reasons for failure of the data to support the model. (1) The indicators of readiness may be too crude. On a priori grounds, lagged test score should be the best indicator of those used. For the analyses in which math test score is the dependent variable, the coefficient on lagged test score does display the predicted pattern across levels of math course work and tends to do so across levels of homework. Not even this modicum of support is observed for verbal test score, however. (2) It is possible, even likely, that four of the measures of readiness--parental status, family income, gender, and race--would be better viewed as indicators of exposure. Such an interpretation would require splitting the sample still further into race, gender, SES, and income levels. Even the large sample size of the HSB would not support analyses within so many subsamples. Simplifying assumptions would be required. (3) The simplifying assumptions imposed as part of the model-building process may not suffice, even as first approximations.

It is concluded that, while the analyses here do not support the interaction model, the hypotheses expressed by the model are strong enough on a priori grounds that further effort to develop and test such a model is justified. In particular, quantitative research will have nothing to offer regarding practical decisions as to which educational experiences are best suited for which students until the characteristics of students and of educational experiences are allowed to interact in determining outcomes.

Study 2: Determinants of High School Work Experience

Because of the high incidence of working among high school students and increasing evidence that working during high school influences post high-school labor market success, it is important to understand the key factors that influence work experience during high school. This paper takes initial steps toward achieving that understanding. It investigates potential effects of a large number of variables on 4 work outcomes during high school--hours worked per week, wage, labor-force participation, and unemployment.

The investigation is carried out within a supply and demand theoretical framework. A utility model of labor supply predicts that hours of labor supplied are primarly a positive function of wage. The standard equilibrium model of supply is expanded in 2 primary respects. First, nonwage work rewards and valuation on school are added to the model, which initially includes only wage and hours. Second, the equilibrium model is generalized to account for changes over time. The demand theory is less formal. It is based on the fundamental idea that employer demand for young employees depends on wage, personal characteristics that are only roughly related to productivity (e.g., race, gender, SES), and on the strength of the local economy.

It is found that wage is not the primary determinant of labor supply, rather a set of attitudes used to reflect nonmonetary rewards of work influence hours and labor-force participation. These attitudes also affect wage and unemployment and are therefore interpreted as affecting employer demand.

Although some behavioral indicators of valuation on school affect hours worked as predicted by the theory, the data indicate that valuation on school does not have a strong impact on work outcomes.

Two personal characteristics have strong effects on employment outcomes. Females earn over 12 cents an hour less than males with the same work experience, attitudes, race, and socioeconomic background. Blacks are over 9 percent more likely to be unemployed than whites, after controlling for work experience, attitudes, socioeconomic background, and school differences.

For educational policy, the primary implication of these findings is that schools should pay attention to development of work-related attitudes of their students. Good attitudes improve work outcomes. The findings indicate support for views expressed in the recent National Commission Report on Secondary Vocational Education (1984). That report calls for a balance of educational goals among a broad spectrum of educational outcomes.

For national employment policy more generally, the findings here reinforce the need to enforce equity provisions of the law to assure females and blacks equal access.

Study 3: Effects of High School Curriculum and Performance on Employment after High School

This study examines the impact of high school curriculum, grades and performance on standardized tests on the early labor market success of high school graduates who do not go to college full time. Two waves of interviews in 1980 and 1982 with the 3,000 seniors from the High School and Beyond Survey who chose not to attend college full time provide the data for the study. Three indicators of labor market success were analyzed: wage rates, number of months employed, and earnings. Bivariate tabulations reveal that:

(1) Among noncollege bound youth, taking additional vocational courses is associated with only a small reduction in the number of academic courses taken.

(2) Taking additional vocational courses is strongly associated with success in the labor market immediately after high school. The 30 percent of non-college bound students who took one or fewer vocational courses, received wage rates that were 7.5 percent lower, worked about 19 percent less and earned 32 percent (about $2,000) less than students who took 4 vocational courses in their last 3 years in high school.

(3) The total amount of academic and vocational course work has a moderate association with greater success in the labor market. Students who took 16 or more full-year academic or vocational courses during their final 3 years in high school earned a 7 percent higher wage and 24 percent more income in 1981 while working only 2 percent more months than students who took fewer than 10 courses.

(4) For the noncollege bound student, taking additional academic courses is not associated with higher earnings immediately after high school. Graduates who took 12 to 14 full-year academic courses in their final 3 years in high school worked 8.5 percent less, received a 3.5 percent lower wage rate and earned 14 percent less in 1981 than students who took 6 to 8 full-year academic courses.

Multivariate models predicting these outcomes were estimated controlling for social background--family income, education and occupation of the mother and father, family structure (number of siblings), and for attitudes and habits measured toward the end of senior year--locus of control, self esteem, work attitudes. These models reveal that:

(5) The associations described in points 2, 3, and 4 seem to reflect causal processes. Controlling for the students background, attitudes, grades, and test scores does not change the nature of the underlying relationships. In the simple model (table 5) four vocational courses increases a male's wage rate by a significant 5.6 percent, months employed by 4.8 percent and earnings by statistically significant 12 percent. For females the increases are 1.6 percent for wage rates. A statistically significant 9.7 percent for months worked and a statistically significant 15.7 percent for earnings. For women academic course work has statistically significant negative effects on all three outcomes.

(6) While for most students a small increase in the number of vocational courses taken and an equal reduction in the number of academic courses will increase earnings, the earnings benefit of such a substitution falls as the number of such vocational courses increases and the number of academic courses declines. <u>In other words academic and vocational course work have complementary effects on the earnings of high school graduates who do not go to college full time.</u> The mix of courses that maximizes earnings in the calendar year after high school is:
--about 36 percent vocational for males.
--about 48 percent vocational for women.

<u>Study 4: Time Profile of Youths' Labor Market Outcomes</u>

High school education and experience influence youthful workers' labor market outcomes. These outcomes are determined by youths' ability to find jobs, to perform on the jobs, and to keep them. In this study, the impact of three aspects of high school education on the labor market outcomes are analyzed. The first is curriculum: combination of basic academic (English and mathematics) courses, other academic courses, and vocational education. The second is the level of achievement and student's ability. The third is work experience in high school. The post high-school work outcomes are hours worked per week, wage, and earnings.

The analysis is based on high school graduates who did not attend post-secondary school as full-time students. It is assumed that the major activity of these students is participation in the labor market. High school experiences are some of the most important factors in determining the labor-market outcomes for those youths.

The data are obtained from the two waves of the 1980 High School and Beyond (HSB) Senior Cohort Survey. The initial wave covered more than 12,000 high school seniors from about 1,000 schools in the spring of 1980 and the follow-up survey was conducted 2 years later. The first survey collected a wide range of facts: socio-economic or family background, course work, grades in various courses, work experience, and attitude and aspiration information. Also at the time of the first survey, students took standardized tests in reading, vocabulary, and mathematics. Scores on these test provide good measures of student's basic skill level. The second survey asked the detailed questions about students' labor market experience after graduation. From these questions we constructed a history of students' labor market outcomes. This data set allows analysis of the time profile of the effect of high school experience.

Analysis of the longitudinal data on earnings suggests that all three aspects of high school experience improve students' earnings after graduation, but differences are found in the time patterns of the effects. We found the following:

- Work experience in high school is strongly associated with higher earnings right after graduation and the positive association persists over the 21-month period after graduation. However, its magnitude and importance diminish over time. Those who worked 20 hours per week through the last three years in high school earn 17 to 20 percent more than the students with no work experience in high school or in the first 3 months after graduation. However, the relative advantage in weekly earnings due to high school work experience declines to about 10 percent after 21 months from graduation.

- Vocational education has a positive effect on earnings. Amount of course work in vocational education is positively associated with higher earnings in the beginning, and its positive effects continue to increase in the next 21 months. Two years of high school vocational education increases earnings by 5 percent in the first 3 months after graduation. The effects of vocational education persist and its relative importance increases over the next 18 months. Twenty-one months after graduation, increases in earnings is 7 percent for males, and more than 10 percent for females.

- The effects of basic skills (in mathematics and English) show a similar time pattern as vocational education. Those with higher basic skills earn more than those with low skills from the very early stage in the labor market and the difference increases with time. One standard deviation increase in the test score predicts nearly 10 percent increase in earnings after 21 months from graduation. On the other hand, amount of course work in basic skills does not show any significant effects on earnings. It implies that amount of course work in basic skills, per se, is not important but the effectiveness of basic education is.

These findings are examined more closely by looking at the time profile of wage rate and work hours. Sequential analysis of work hours and wage rates revealed the following relations:

- There are distinctive differences in the effects of work experience between males and females. For males, the difference in work experience results in wage difference. In the first 3 months after graduation, those who worked through high school earn $1.00 per hour (33 percent) more than the students with no work experience. Although the wage gap diminishes gradually over the observation period, it does not disappear after 21 months. By the end of the 21-month period, the difference is reduced to about 50 cents per hour. In contrast to males, throughout the observation period no difference is found in females wage rate by work experience. The impact on work hours diminishes gradually for both males and females but the differences between gender are found in the impact of summer work. For males, after 3 months from graduation, there is little difference in work hours between those who worked through high school and those who worked only in the summer. On the other hand, for the females a major gap is found between those who worked through high school and those who did not work during regular school time. Differences in weekly work hours are 11 hours (34 hours to 22 hours) in the first three months and 8 hours (34 hours to 26 hours) after the 21 months from graduation.

- Course work in vocational education has lasting positive effects on both wage rate and work hours of males, but its effect for females is mainly on work hours. During the 4th month to the 21st month after graduation, an additional 2 years of vocational courses increases men's weekly work hours by a significant 2 hours (6 percent) and the wage rate by 12 cents per hour. For females, the effect of vocational education is about the same as males in terms of its impact on weekly work hours but no positive association is found between wage rate and vocational course work.

- In addition to the amount of course work, good performance in vocational courses further raises wage rates for both males and females. Male students who specialize in trade-technical courses and received good grades enjoy higher pay per hour through the observation period. Males who received mostly A's and B's in trade and technical courses get paid about 45 cents per hour (10 percent) more than those who didn't. Females' good performance in business and office courses results in higher wages in the beginning but its effect fades 18-months after graduation.

- Students with higher skills in mathematics and English work more hours per week and the magnitude of the effect is quite stable. For both males and females, a one standard deviation (8 points) increase in the test score is associated with statistically significant 2-hour increase in weekly work hours throughout the observation period. However, no significant relation is found between basic skills and hourly earnings. It follows that positive association between basic skills and weekly earnings is the result of longer work hours.

In order to explain the above findings, two models describing the relationship between wage rates and job training are presented. In the first model there is a ceiling in productivity and the job training in high school is a substitute for on-the-job training. The model predicts that those who have had job training in high school receive higher wage in the beginning but the advantage disappears after the training period is over.

In the second model, job training in high school complements on-the-job training. It predicts long-lasting effects of high school job training on wage rates. Observed patterns of the effects of job training seem to indicate that females' labor market experiences are better explained by the first model and the second model is a better description of male labor market outcomes.

CHAPTER 1

LEARNING AS A PRODUCT OF EXPOSURE AND READINESS

Lawrence Hotchkiss

Basic skills comprise a critical element in preparing youth for employment. Consequently an important component of research on employability development must be study of how schooling fosters development of basic skills. A large and growing empirical literature on effective schools has focused in large measure on test-score outcomes as measures of basic skills. Beginning with publication of the Equal Educational Opportunity Report (EEOR) in 1960 (Coleman et al. 1966), a standard linear model has frequently been applied to investigate effects of differences among schools on development of basic and academic skills (e.g., Smith 1972; Mayeske et al. 1975; Alexander, McPartland, and Cook 1981; Rutter et al. 1979). For the most part, having found small differences in test-score outcomes among schools, other investigators have noted the importance of examining different experiences to which students within a given school are exposed. Again, the standard linear model has been widely applied (e.g., Murnane 1975; Heyns 1978; Wiley 1976; Karweit 1976).

A downward trend in high-school student scores on the SAT over the past several years (interupted in the past year) has stimulated an upsurge of interest in effective schooling practices at the high school level (National Commission on Excellence in Education 1983; Boyer 1983; Goodlad 1983; National Commission on Secondary Vocational Education 1984). One important aspect of the call for reform is a recommendation to increase the number of academic courses required of high school students. Many states and local school districts have responded by increasing these requirements. Of course, students who take more academic courses have less time left over to take other courses. It has been speculated that not all youth benefit uniformly from taking academic courses (Thurow 1979; National Commission on Secondary Vocational Education 1984). Some youth may benefit so little that it is not worthwhile for them to take some courses. Others may be better off taking vocational courses where they not only prepare for employment but also may improve their basic skills. To date, however, little serious investigation of these possibilities has been conducted.

A major barrier to quantitative investigation of the simple idea that not all youth derive the same benefit from the same educational experience is the nearly universal, routine reliance on the linear model. A typical linear specification of a learning function may include both measures of ability (or, more generally, readiness) and exposure to new material (e.g., courses taken, amount of homework). The problem with the linear specification is that it implies all students learn to the same degree the subject matter presented to them. In this view, a unit of ability is a perfect substitute for a unit of exposure, and a unit of exposure is a perfect substitute for a unit of ability. On the other hand, if one believes that youth differ, for whatever reason, in their capacity to learn, then the rate at which one learns new material is higher for those with high ability to learn than for others. This argument implies that readiness or ability interacts with exposure to produce the learning rate. The simplest expression of this interaction is a product model. That is, learning is produced by the product of readiness x exposure. In contrast, the linear model implies that learning is determined by the sum of readiness and exposure--learning rate = readiness + exposure.

This paper carries out a number of preliminary investigations of an interaction specification of the effects of readiness and exposure on learning rate. Two dependent variables are studied: (1) verbal test score, and (2) mathematics test score. Time-2 measures of these variables are used as the outcomes to be explained. Because of the relative difficulty of using a product model instead of a linear model, the set of independent variables is small. Indicators of exposure include amount of course work in two academic subjects (English, math), two vocational subjects (business and office, technical), and amount of homework.

In this paper the term learning readiness is intended to include all aspects of individuals that make them differ in their capacities to learn. Readiness is therefore a complex mixture of inherent and learned abilities. The primary indicator of readiness used in this paper is the time-1 test score--on the grounds that what one already knows about a subject is the best available indicator of readiness or ability to learn more. The usual controls for socioeconomic background and personal characteristics also are included, except here these variables are interpreted as additional indicators of readiness. It should be noted that the primary concern of this paper is to develop and test a preliminary structural model that expresses the simple idea that not all youth benefit equally from the same experiences. If the preliminary models tested here yield promising results, then future research should devote additional energy to improving the operational measures of readiness and exposure and to refining the specification of the model to reflect more precisely our best hypotheses about the process of learning.

Theoretical Model

In broad outline, the linear model of learning may be written in the following terms:

(1) learning = a + b · readiness + c · exposure,

where a, b, and c are constants, generally estimated by linear regression. This type of model has been used nearly universally to study effects of different aspects of readiness (e.g., IQ test) and exposure (e.g., time in class) on learning. The primary problem with this specification can be seen by looking at the effects of readiness and exposure on learning. The effect of readiness = b--a constant. This result implies that the effect of readiness is the same irrespective of the amount of subject material to which one is exposed. The most extreme instance of the absurdity of this viewpoint is that it implies learning of material to which one has not been exposed. If exposure is zero, learning is directly related to readiness alone. Likewise, the linear model implies that the effect of exposure = c--also a constant. This means that all people learn material to which they are exposed at the same rate. In the extreme case, a "moron" and a "genius" benefit equally from exposure to one additional piece of information about advanced physics.

These aspects of the linear model quite obviously do not reflect our best hypotheses about the process of learning. Yet, it would be naive to dismiss the linear specification out of hand because it fails to express every subtle aspect of our intuitive understanding of learning. First, experience shows that the linear model is robust--it gives reasonably good results under a variety of situations in which it is not, on strickly technical grounds, appropriate. In particular, it will produce a fairly good approximation of a nonlinear function over a restricted range provided tnat the nonlinear function does not fold back on itself. Second, application of the linear model with data is routine; even the most elementary nonlinear forms often pose practical roadblocks.*

In view of these considerations, resort to a nonlinear specification ought to be done only for compelling reasons. On the face of it, the problems with the linear model just recited seem sufficient in themselves, except that the linear model may produce a close enough approximation over the limited range of data typically available for analysis. Part of the purpose of this paper is to find out whether a nonlinear model of learning expressing important subtleties of the process that are ignored in a linear model produces sufficient improvement in the statistical fit to justify the added complexity.

But there is another more practical reason for examining the nonlinear model. Since the linear model implies that all students benefit equally from any of a variety of educational experiences, quantitative research based on it offers no hope of helping educators with day-to-day decisions about which students can benefit most from which experiences. In particular, research based on the linear model can be of no help in determining an optimum mix of academic and vocational courses.

Objections to the linear model of learning occassionally have been raised in the literature (e.g., Sørensen and Hallinan 1977; Walberg 1981; McPartland and Karweit 1979; Hotchkiss 1984).** Sørensen and Hallinan (1977) propose a very general specification that is pertinent to the present study. They postulate that--

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

where f is an unspecified positive function. An important conceptual difficulty with this formulation is that it ignores the fact that people forget information. Since f is a monotonically positive function of both readiness and exposure, and since neither readiness nor exposure are conceived of as assuming negative values, a negative learning rate is not possible in (2). One way

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*Even when the model is linear in the coefficients, multicolinearity produced by powers and products in the X'X matrix often renders estimates of coefficients unstable.

**The theoretical presentation in this section is an expansion of the work reported in Hotchkiss (1984), Chapter 6.

to resolve this difficulty is to define learning as the acquisition of new knowledge--so that it cannot in principle be negative. Then equation (2) can stand as it is. While this resolution is satisfying conceptually, it will not do for most empirical work, because it generally is not feasible to observe directly the acquisition of new knowledge. What we observe are standardized test scores. The difference between test scores at two points in time reflects not only acquisition of new knowledge but also information that has been forgotten. Consequently, in order to make use of equation (2) in most empirical settings, it is necessary to augment it with a "forgetting function."

To the end of developing a model that has a sensible interpretation when used with test score data, let y represent the current level of knowledge as indexed by a test score. Then the change in y is determined by--

(3) Δy = (learning rate - forgetting rate) Δt,

where Δy = change in y, and Δt is an increment of time.

Each person absorbs a certain proportion of the new information to which he or she is exposed in a given time interval. The proportion absorbed depends on the individual's ability or learning readiness--

(4) learning rate = R x E,

where R and E are adopted as shorthand notation for readiness and exposure rate.

As a very rough first approximation, assume that a constant proportion of current information is forgotten in a given time interval, irrespective of learning readiness or exposure. The forgetting function then can be written as--

(5) forgetting rate = qy, q = positive constant.

Presumably, in fact, q depends on most or all of the same factors that determine readiness and exposure rate. To avoid intractable estimation problems, however, the constant forgetting rate is maintained.

Let readiness depend linearly on current knowledge y and on an exogenous factor x. The function is--

(6) $R = p_0 + p_1 x + p_2 y$

Extension to several exogenous variables is straightforward but is omitted here to avoid unnecessary complexity.

Now, dividing (3) through by Δt, letting $\Delta t \to 0$, substituting (6) into (4) and (4) and (5) into (3) gives the following result:

$$(7) \quad \frac{dy}{dt} = R \times E - qy$$

$$= (p_0 + p_1 x + p_2 y) x E - qy$$

$$(7a) \quad \frac{dy}{dt} = p_0 E + p_1 E x + (p_2 E - q) y$$

It is seen that the coefficients on x and y in the differential equation (7a) depend on exposure rate, E.

For simplicity it is assumed that the exposure rate remains constant over extended periods of time.* The rate differs among individuals, however. There are two ways to conceive of these differences during a set time interval. Case one is that each individual is exposed at a constant rate over the entire interval, but that rate differs among individuals. Examples of this type of difference among people include two people taking the same subject in school with different teachers, two people taking different subjects with partially overlapping content, and two people taking differing numbers of courses on the same subject within the given time interval.

In case 2, people differ in exposure over a set time interval because exposure lasts for differing lengths of time. Obvious examples include two people taking different number of semesters of English or math during their 4-year high school careers.

Integration of (7a) is straightforward for case 1 and leads directly to the prediction that regression coefficients on x and lagged y differ according to exposure rate. The integral form of (7a) is

$$(8) \quad y_2 = \frac{p_0 E}{p_2 E - q}[e^{(p_2 E - q)t} - 1] + \frac{p_1 E}{p_2 E - q}[e^{(p_2 E - q)t} - 1]x + e^{(p_2 E - q)t} y_1;$$

$$(8a) \quad y_2 = a_0^* + a_1^* x + b^* y_1,$$

where e is the base of the natural logarithm. (See Coleman 1968; Doreian and Hummon 1976; Arminger 1983). The regression weights on x and y are given by

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*Sorensen and Hallinan (1977) impose the assumption that exposure to new material is a constant proportion of material remaining to be taught in a given time from a syllabus. In their view, exposure rate therefore is not constant.

$$(9a)\quad a_1^* = \frac{p_1 E}{p_2 E - q}[e^{(p_2E-q)t} - 1] \text{ , and}$$

$$(9b)\quad b^* = e^{(p_2E-q)t} \text{ ,}$$

respectively.

It is clear from these results that the regression weight on lagged y (b^*) is a monotonic positive function of exposure, E--

$$(10)\quad \frac{db^*}{dE} = p_2 t e^{(p_2E-q)t} > 0 \quad | \quad p_2 > 0 \text{ .}$$

Therefore, the model predicts that separate regressions calculated within homogeneous exposure levels will produce higher regression coefficients on lagged y among youth with high exposure than among youth with low exposure. This result agrees with Sørensen and Hallinan (1977).

The effect of increasing exposure on the coefficient for x is not so clear, however. The derivative of that coefficient with respect to exposure is--

$$(11)\quad \frac{da_1^*}{dE} = p_1\left[\frac{p_2^2E^2te^{(p_2E-q)t} - p_2Eqte^{(p_2E-q)t} + q(1-e^{(p_2E-qt)})}{(p_2E-q)^2}\right] \text{ .}$$

Since $p_1/(p_2E-q)^2 > 0$, the sign of the derivative is determined by the messy numerator term inside the square brackets. It is not obvious from inspection that this term is always positive; hence, the correspondence between the coefficient on x (a_1^*) and exposure appears to be ambiguous. Having carried out numerous numeric calculations, however, I have not found any combination of the paramaters that fails to produce a positive derivative; generally the effect of changing exposure in those calculations produced a stronger response on the x coefficient than on the coefficient for lagged y. The same conclusion applies to the intercept. These conclusions regarding the response of the a_j^* coefficients do not agree with Sørensen and Hallinan.

Recall that in case 2 people differ in exposure during a given time interval due to different lengths of time of exposure. To determine the impact of increased exposure in this instance on the regression coefficients, it is assumed that exposure is "front loaded," meaning that it starts at the beginning of a period and runs continuously at a constant rate until it ends. After it ends, it does not start again. The assumption of front loading is at best a very rough approximation, but again it is necessary to impose simplification on the model in order to proceed.

To derive the correspondence between exposure and the regression coefficients for case 2, the differential equation is integrated in segments over the period between measurements. The first segment corresponds to the period of heightened exposure, the second to reduced exposure. The resulting equations, though uncomplicated in principle, are ungainly in appearance. They do lead to the unambiguous prediction that both the coefficient on x and on lagged y are positively connected to exposure--as exposure increases, so do the regression coefficients. The model also predicts that the intercept is positively related to exposure.

Data and Variables

The sample for this study consists of the base year and first follow-up surveys of the Sophomore cohort of the High School and Beyond (HSB).* The sample includes 30,030 sophomores attending 1,015 U.S. high schools in 1980. These same individuals were surveyed again in 1982 when they would have been seniors in high school, providing they progressed at the modal rate. Respondents who did not participate in either the base-year or first follow-up survey were excluded from the analyses, leaving a base of 27,118 cases. High school dropouts also were excluded, reducing the sample size to 24,697. In addition, varying numbers of cases were deleted in specific analyses. Each case in which the value of the dependent variable or an interaction variable (English classes, math classes, business and office classes, technical classes, and homework) was missing also was deleted.

Two dependent variables are used in the empirical tests of the model--mathematics test score and verbal test score. Measures of these two variables

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*See Frankel, et al. (1981) and Jones, et al. (1983) for description of the sample. Coleman, Hoffer, and Kilgore (1982) also provide thorough summary of the base-year survey.

are available for the same individuals at their senior and sophomore years in high school.

Five variables are used as indicators of exposure; these are (1) years of course work in English during the junior and senior years of high school, (2) years of course work in business and office during the same period, (3) years of course work in mathematics during the period, (4) years of course work in vocational-technical subjects during the period, and (5) hours of homework per week. Examples of academic and vocational courses were picked deliberately to gain some insight into the degree to which students' knowledge of academic subjects is influenced by academic and vocational course work.

Five variables also are used to index learning readiness. The primary indicator is current level of knowledge in a subject (math or English in the present context). The rationale for using current level of knowledge is that ability to learn new material depends on what is already known. The more one knows at present, the easier it is to learn additional information. Additional indicators of readiness are race, gender, an index of parental socioeconomic status, and family income. These latter four variables are choosen in deference to historical precedent rather than a tightly reasoned theory about determinants of readiness. Few quantitative studies of determinants of learning have been conducted without controls for socioeconomic background and personal characteristics such as race and gender. Small effects of these variables on test scores have been observed repeatedly.

The income variable is converted to logarithms. The index of family status consists of the average of both parent's education, occupational status, and number of possessions in the home, each converted to standardized scores ($\bar{X}=0$, SD=1) prior to calculating the index value.

The income and status variables were measured from student reports taken from the base year survey. Race and gender were measured using combined information from both waves of the survey. Time-2 test scores were collected during the first follow-up, and time-1 test scores were collected during the base year survey.

Analysis

The statistical analysis is carried out with linear regression within subsamples of relatively homogeneous exposure levels. Since the HSB sample is large, it is feasible to carry out analyses within fairly fine subdivisions of it. The following categories of each of the 5 exposure variables along with the percentage of the sample in each are laid out as follows:

Mathematics course work

MATH 0 -- 0 to 1/2 yrs.	6.2%
MATH 1 -- 1 to 1 1/2 yrs.	24.9
MATH 2 -- 2 to 2 1/2 yrs.	33.3
MATH 3 -- 3 or more yrs.	35.6

Technical-vocational course work

TECH 0 -- none	77.8%
TECH 1 -- 1/2 to 1 1/2 yrs.	13.2
TECH 2 -- 2 to 2 1/2 yrs.	5.3
TECH 3 -- 3 or more yrs.	3.7

English course work

ENGL 0 -- 0 to 1 1/2 yrs.	3.4%
ENGL 1 -- 2 to 2 1/2 yrs.	16.3
ENGL 2 -- 3 yrs.	56.5
ENGL 3 -- more than 3 yrs.	23.8

Business and office course work

BUSO 0 -- 0 to 1/2 yrs.	46.2%
BUSO 1 -- 1 to 1 1/2 yrs.	25.9
BUSO 2 -- 2 to 2 1/2 yrs.	15.4
BUSO 3 -- 3 or more yrs.	12.5

Homework

HWRK 0 -- less than 2 hrs/week	18.2
HWRK 1 -- 2 to 3 1/2 hrs/week	28.1
HWRK 2 -- 4 to 7 hrs/week	24.8
HWRK 3 -- 7 or more hrs/week	28.9

Five sets of analyses were carried out for each of the two dependent variables. For mathematics, one set was conducted within levels of math course work, one set within levels of technical course work, one set within levels of homework, one set within combined levels of math and technical courses, and one set within combined levels of math and homework categories. For verbal test score, analyses were conducted within levels of English course work, levels of business and office course work, levels of homework, combined levels of English and business and office course work, and combined levels of English course work and homework. The latter 2 sets of regressions do not reveal much additional information, however; consequently, coefficient estimates associated with them are not tabulated.

For each of these subdivisions of the sample, linear regressions of the following form are reported:

$$(12) \quad y_2 = a_0^* + a_1^* x_1 + \ldots + a_4^* x_4 + b^* y_1 \ ,$$

where

y_2 = senior year math or verbal test score,
x_1 = race (1=black, 0 otherwise),
x_2 = gender (1=female, 0=male),
x_3 = index of family status,
x_4 = log of family income,
y_1 = sophomore year math or verbal test score, and
a_i^*, b^* = regression coefficients.

The theoretical model predicts that each of the regression coefficients including the intercept will be positively related to the level of exposure.

Additionally, unconditional linear regressions including dummy variables for each level of exposure (except one) are reported for various combinations of the exposure variables.

Findings

The findings are reported separately for mathematics and verbal test scores. Mathematics is presented first. Table 1.1 reports regression coefficients for a sequence of unconditional linear specifications, each corresponding to one interaction specification to be reported subsequently. The linear models are reported primarily to provide a basis of comparison, but they do reveal interesting results. According to the estimated effects displayed in the table, years of math course work have by far the strongest effects on growth in math achievement.* The more math course work taken, the higher the

*Equation (12) is equivalent to a growth model in which Δy appears on the left.

TABLE 1.1

UNCONDITIONAL LINEAR SPECIFICATIONS OF EFFECTS OF READINESS AND EXPOSURE ON MATH TEST SCORE

(Dependent variable = math test score, time 2)

Independent Variable	Mathematics Course Work	Technical Course Work	Homework	Mathematics & Technical Course Work	Mathematics Course Work & Homework
Intercept	11.1610***	10.2958***	10.7270***	11.1382***	11.4344***
Lagged math test score	.7693***	.8198***	.8144***	.7689***	.7569***
Race (1=black)	-1.9889***	-1.3662***	-1.3454***	-2.0036***	-1.9429***
Gender (1=female)	-.5146***	-.6853***	-.7763***	-.4965***	-.7596***
SES index	1.0976***	1.3712***	1.3059***	1.0958***	1.0163***
Family income	.5303***	.5640***	.5512***	.5276***	.5009***
Math 1	.0989			.0930	-.0660
Math 2	1.0973***			1.0904***	.8591***
Math 3	3.5882***			3.5797***	3.1551***
Hwrk 1			-.3596**		.6983***
Hwrk 2			.2267+		1.2646***
Hwrk 3			1.5523***		1.9273***
Tech 1		.3550*		.3405*	
Tech 2		-.3064		-.1662	
Tech 3		-.0101		-.0634	
Corrected R^2	.6746	.6563	.6585	.6746	.6783
N	20775	20775	20624	20775	21548
F	390.5749	[illegible].0110	39.7512	196.9558	241.2103
p	.0001	.01	.0001	.0001	.0001

+ $p \le .05$.
● $p \le .10$.
* $p \le .01$.
** $p \le .001$.
*** $p \le .0001$.
(2-tailed test)

test score. Hours of homework per week also have a fairly strong effect, but not as strong as math courses. Again the effect is positive as one would expect, but it is slightly nonlinear. The pattern of coefficients on technical courses also is nonlinear. Those taking 1/2 to 1 1/2 years of technical course work learn more math than those taking no technical courses and more than those taking 2 or more years of technical course work. These effects are hardly changed by including more than one type of exposure variable.

Table 1.2 presents estimates under the interaction model taking the exposure variables 1 at a time. Each panel of table 1.2 corresponds to one of the first three columns of table 1.1. Since the models with dummy variables for the top three levels of exposure, in effect, test for differences among the intercepts, the F-tests in table 1.2 test for differences among slopes. All three are statistically significant.

The expected pattern of increasing slope coefficients for increasing exposure is quite clear on the lagged dependent variable in the four levels of math course work. The pattern here is fairly strong with no reversals. The pattern on the coefficients for lagged math test in the four levels of homework is comparatively ragged, but tends to support the predictions of the interaction model in that the coefficient in the highest homework level is substantially higher than the rest. The coefficients on the other independent variables exhibit such erratic patterns that it is difficult to characterize them as a group. It is notable, however, that the intercepts within the levels of math course work decrease as homework goes up--just the opposite of the pattern predicted by the model.

Table 1.3 presents regressions within each of the 16 levels of exposure produced by cross-classifying the 4 levels of math course work with the four levels of technical course work. The motivation underlying this analysis is to take a preliminary step toward identifying an optimum mix of math and technical courses for persons of differing levels of readiness. For instance a simple calculation based on the data in table 1.3 indicates that a white male from a family of average (log) income who is selecting between 3 math courses and 2 math courses and 1 technical course would be better off taking the three math courses so long as his base year math test score were above 41.4 (ave=50, SD-9.2); otherwise, he is better off with 2 math courses and 1 technical

TABLE 1.2

ONE-WAY INTERACTION MODELS OF EFFECTS OF EXPOSURE AND READINESS ON MATH TEST SCORE

(Dependent variable = math test score, time 2)

Independent Variable	Math 0 (1243)	Math 1 (4909)	Math 2 (6928)	Math 3 (7694)
Intercept	21.5258***	16.2562***	11.1706***	11.7556
Lagged math test score	.6150***	.6645***	.77[illegible]***	.8265***
Race (1=black)	-1.2423+	-1.7967***	-1.5825***	-2.3261***
Gender (1=female)	-.3590	-.5510**	-.2758+	-.6467***
SES index	1.3460***	.6620***	.9878***	1.1911***
Family income	-.7494+	.5221*	.7322***	.5432***

p (no interaction) ≤ .001

Independent Variable	Tech 0 (16373)	Tech 1 (2643)	Tech 2 (1043)	Tech 3 (714)
Intercept	9.9313***	8.9265***	17.0104***	14.5034***
Lagged math test score	.8223***	.8359***	.7524***	.7965***
Race (1=black)	-1.2535***	-1.7196***	-2.3000***	-.3437
Gender (1=female)	-.6487***	-.5420+	-1.4159*	-1.6492+
SES index	1.4310***	.8306***	1.8458***	.9830+
Family income	.6185***	.8359**	-.3464	-.1402

p (no interaction) ≤ .001

Independent Variable	Hwrk 0 (8292)	Hwrk 1 (5693)	Hwrk 2 (5104)	Hwrk 3 (1534)
Intercept	10.0819***	10.7957***	12.8269***	9.9814***
Lagged math test score	.8174***	.8015***	.8030***	.8760***
Race (1-black)	-1.4118***	-1.3029***	-1.2528***	-1.1531+
Gender (1=female)	-.5571***	-.6470***	-1.3320***	-1.1002**
SES index	1.4639***	1.1738***	1.2851***	.8459**
Family income	.6066***	.5506**	.4026+	.3906

p (no interaction) ≤ .001

NOTE: Numbers in parentheses are sample sizes.

+ p ≤ .05.
• p ≤ .10.
* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.
(2-tailed test)

TABLE 1.3

TWO-WAY INTERACTION MODEL OF EFFECTS OF EXPOSURE AND READINESS ON MATH TEST SCORE: MATH AND TECHNICAL COURSE WORK

(Dependent variable = math test score, time 2)

	Tech 0	Tech 1	Tech 2	Tech 3
Math 0	(975)	(136)	(88)	(44)
Intercept	19.5543***	16.7475**	43.7776***	22.8623*
Lagged math test score	.6240***	.6211***	.6143***	.5477***
Race (1=black)	-.9131	-.5854	-6.9479+	--(no blacks)
Gender (1=female)	.0074	-.0685	-4.0551+	1.3240
SES index	1.1272***	.7327	5.1967***	-1.9162
Family income	-.4798	.8079	-6.4290***	-1.0826
Math 1	(3868)	(576)	(274)	(192)
Intercept	16.2625***	15.4004***	17.8627***	15.0427**
Lagged math test score	.6626***	.6594***	.6657***	.6930***
Race (1=black)	-1.6681***	-2.4967**	-2.7052+	-.9323
Gender (1=female)	-.4985*	-.0441	-1.2357	-.1870
SES index	.6945***	.4935	.1536	1.1322
Family income	.4864*	.8369●	.3123	.3803
Math 2	(5528)	(856)	(349)	(196)
Intercept	10.6705***	10.7591***	18.7957***	14.9503**
Lagged math test score	.7773***	.7679***	.7052***	.7449***
Race (1=black)	-1.4754***	-1.4618+	-3.3367**	-1.6016
Gender (1=female)	-.2545	-.4766	-1.2131	-1.5501
SES index	1.0493***	.3248	1.2273+	.8667
Family income	.7847***	1.0378+	-.5078	.3027
Math 3	(6002)	(1075)	(333)	(284)
Intercept	11.1832***	12.5875***	15.2180***	17.1414***
Lagged math test score	.8271***	.8303***	.7619***	.8623***
Race (1=black)	-2.2896***	-3.1143***	-2.2674+	-.3604
Gender (1=female)	-.4734*	-.8589+	-1.0933	-3.3084*
SES index	1.2730***	.6991*	1.6605*	.6007
Family income	.6110***	.4784	.6804	-1.0083

p (no interaction) ≤ .001

NOTE: Numbers in parentheses are sample sizes.

+ p ≤ .05.
● p ≤ .10.
* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001
(2-tailed test)

course. Of course, this calculation is given strictly for illustrative purposes--to show that the model at least reflects important aspects of the process under study. A linear model does not support this type of comparison. Certainly, one would not want to take the present calculation seriously. Much more investigation is needed before sufficient confidence in the model and empirical estimates could be achieved. It is doubtful, in fact, whether one would ever want to use a statistical model of any kind to make decisions regarding the curriculum that individuals should follow. However, any model that fails to account for the possibility that different course work is optimum for different people omits an important substantive feature of the process.

The data in table 1.3 tend to replicate patterns observed in table 1.2. Within levels of technical course work, the coefficient on lagged math test score increases monitonically with amount of math course work, without exception. The intercepts tend to decrease within levels of math course work. Otherwise, the patterns are erratic.

Table 1.4 shows regressions within levels of math course work and homework. Again, the increasing value of the coefficient on lagged math test score is observed within levels of homework, with only one exception. The decreasing value of the intercept is also observed across increasing levels of math course work. The patterns on homework within levels of math course work are erratic; they do not support the theoretical model.

Table 1.5 reports estimates of coefficients in additive models where verbal test score (time 2) is the dependent variable. As with the analysis of mathematics, each additive model corresponds to one interaction model. The additive effects of both English and business and office courses are nonlinear. Verbal test score increases as the amount of English or business and office course work increases, up to a point, then decreases. The turning point occurs sooner for business and office than for English. One possible explanation for the curvilinear relation in the case of English courses is that some English courses taken in the last year are repeated courses that students failed earlier, or they are remedial courses. The additive effects of homework on verbal test score are as one would expect-- more helps.

TABLE 1.4

TWO-WAY INTERACTION MODEL OF EFFECTS OF EXPOSURE AND READINESS ON MATH TEST SCORE: MATH COURSE WORK AND HOMEWORK

(Dependent variable = math test score, time 2)

	Hwrk 0	Hwrk 1	Hwrk 2	Hwrk 3
Math 0	(368)	(450)	(273)	(174)
Intercept	23.3754***	19.1073***	25.7519***	18.5991***
Lagged math test score	.5722***	.6928***	.4949***	.6684***
Race (1=black)	-.0642	-.8953	-2.6586	-2.2410
Gender (1=female)	-.6621	-.7753	.0579	-.4717
SES index	.6842	1.4535*	1.4004+	1.3198+
Family income	-.7753	-.9085•	-.2579	-.5388
Math 1	(1216)	(1650)	(1214)	(1032)
Intercept	17.3012***	17.0506	19.7690***	11.5631***
Lagged math test score	.6206***	.6590***	.6259***	.7393***
Race (1=black)	-1.5255*	-2.1460***	-1.5434*	-1.8865**
Gender (1=female)	-.8489+	-.5226•	-1.0555*	-.0845
SES index	.3060	.7509*	1.0459**	.4447
Family income	.8777*	.2779	.2599	.7388•
Math 2	(1296)	(2037)	(1925)	(1940)
Intercept	11.5688***	12.1169***	12.3010***	13.6105***
Lagged math test score	.7591***	.7403***	.7722***	.7513***
Race (1=black)	-1.1717*	-1.5314***	-1.8043***	-1.2718*
Gender (1=female)	-1.1704**	-.4530•	-.4919•	-.0515
SES index	.9197**	.9699***	.9390***	.9071***
Family income	.8989*	.8385*	.5534+	.4220
Math 3	(923)	(1825)	(1889)	(3336)
Intercept	11.5465***	9.4917	12.8855	16.4834***
Lagged math test score	.8387***	.8358***	.8228***	.7749***
Race (1=black)	-2.6095***	-1.7961***	-1.6632**	-2.1949***
Gender (1=female)	-1.2076*	-.1596	-1.0660***	-1.1464***
SES index	-1.0879**	1.1603***	.8153**	1.2563***
Family income	.1075	.7846*	.4561	.3951•

p (no interaction) ≤ .001

NOTE: Numbers in parentheses are sample sizes.

+ p ≤ .05.
• p ≤ .10.
* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001
(2-tailed test)

TABLE 1.5

UNCONDITIONAL LINEAR SPECIFICATIONS OF EFFECTS OF READINESS
AND EXPOSURE ON VERBAL TEST SCORE

(Dependent variable = verbal test score, time 2)

Independent Variable	English Course Work	Business & Office Course Work	Homework	English & Business & Office Course Work	English Course Work & Homework
Intercept	7.9478***	9.0618***	9.1519***	7.9354***	8.1715***
Lagged verbal test score	.8450***	.8532***	.8493***	.8453***	.8313***
Race (1=black)	-1.5941***	-1.5553***	-1.5685***	-1.5821***	-1.5863***
Gender (1=female)	.3509***	.3161***	.3631***	.2891***	.2172**
SES index	.7714***	.8052***	.7587***	.7814***	.7200***
Family income	.4066***	.4090***	.4174***	.4005***	.3392***
Eng 1	1.2779***			1.2472***	1.2414***
Eng 2	1.9326***			1.9030***	1.8183***
Eng 3	1.4554***			1.4201***	1.3455***
Hwrk 1			.0554		.8240***
Hwrk 2			.3230***		1.1201***
hwrk 3			1.0727***		1.5457***
Buso 1		.3295***		.3065***	
Buso 2		.2322+		.2188+	
Buso 3		.2295+		.1810●	
Corrected R^2	.7447	.7430	.7432	.7448	.7476
N	21386	21386	21334	21386	21853
F	54.2289	6.2547	24.2917	29.8168	71.1218
p	.0001	.001	.0001	.0001	.0001

+ $p \leq .05$.
● $p \leq .10$.
* $p \leq .01$.
** $p \leq .001$.
*** $p \leq .0001$.
(2-tailed test)

Table 1.6 reports 3 sets of regressions: one carried out within levels of English course work, one conducted within levels of business and office course work, and one within levels of homework. The predicted patterns of the regression coefficients are not observed, and, in fact, the slopes do not even differ significantly among levels of English course work. In fact the coefficients on lagged verbal test score decline across levels of homework and levels of business and office course work. The intercepts do display the expected pattern across business and office course work and homework.

Models also were estimated within levels defined by cross classifying English course work and business and office and within the cross classification cells of English course work and homework. These calculations did not reveal any significant new patterns, so the coefficients are not tabulated here.

Reflections

This paper sets out to develop and test an interaction model of achievement in math and verbal skills. The interaction model reflects good substantive hypotheses about the process of learning that are contradicted by the usual linear model. In particular, the interaction model expresses the ideas that the effect of capacity to learn on achievement increases as exposure to new subject content increases and that the effect of exposure to subject content increases as capacity to learn increases.

The data do reveal statistically significant interactions among indicators of learning readiness (or capacity to learn) and indicators of exposure. But the patterns of interaction do not conform to those predicted by the theoretical model. There are several possible reasons for failure of the data to support the model. (1) The indicators of readiness may be too crude. On a priori grounds, lagged test score should be the best indicator of those used. For the analyses in which math test score is the dependent variable, the coefficient on lagged test score does display the predicted pattern across levels of math course work and tends to do so across levels of homework. Not even this modicum of support is observed for verbal test score, however. (2) It is possible, even likely, that four of the measures of readiness--parental status, family income, gender, and race--would be better viewed as indicators of exposure. Such an interpretation would require splitting the sample still

TABLE 1.6

ONE-WAY INTERACTION MODELS OF EFFECTS OF EXPOSURE AND READINESS ON VERBAL TEST SCORE
(Dependent variable = verbal test score, time 2)

Independent Variable	Engl 0 (739)	Engl 1 (3364)	Engl 2 (12071)	Engl 3 (5212)
Intercept	8.8463***	9.8631***	9.8827***	8.9537***
Lagged verbal test score	.8010***	.8406***	.8502***	.8448***
Race (1=black)	-2.1047***	-1.8748***	-1.4765***	-1.4525***
Gender (1=female)	.0767	.4636*	.2976**	.4051*
SES index	1.3799***	.7639***	.7422***	.7460***
Family income	1.0448*	.2077	.3356***	.5297***

Interaction not statistically significant

Independent Variable	Buso 0 (9811)	Buso 1 (5674)	Buso 2 (3316)	Buso 3 (2585)
Intercept	8.3223***	9.8146***	10.7039***	11.9636***
Lagged verbal test score	.8675***	.8471***	.8308***	.8122***
Race (1=black)	-1.5190***	-1.6394***	-1.3429***	-2.0085***
Gender (1=female)	.4357***	.1052	.0545	.3349
SES index	.9127***	.6783***	.7804***	.2574
Family income	.3496**	.4901***	.4553*	.1722

p (no interaction) ≤ .001

Independent Variable	Hwrk 0 (3857)	Hwrk 1 (5910)	Hwrk 2 (5286)	Hwrk 3 (6554)
Intercept	7.8741***	9.8585***	10.7247***	12.3297***
Lagged verbal test score	.8600***	.8538***	.8291***	.8386***
Race (1=black)	-1.6902***	-1.3011***	-1.5614***	-1.7117***
Gender (1=female)	.4907***	.3656*	.1189	.0504
SES index	.8123***	.7957***	.5882***	.6962***
Family income	.6104***	.0964	.4808**	.0937

p (no interaction) ≤ .001

NOTE: Numbers in parentheses are sample sizes.

+ p ≤ .05.
* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001
(2-tailed test)

further into race, gender, SES, and income levels. Even the large sample size of the HSB would not support analyses within so many subsamples. Simplifying assumptions would be required. (3) The simplifying assumptions imposed as part of the model-building process may not suffice, even as first approximations.

While the analyses here do not support the interaction model, the hypotheses expressed by the model are strong enough on a priori grounds that further effort to develop and test such a model seems justified. In particular, quantitative research will have nothing to offer regarding practical decisions as to which educational experiences are best suited for which students until the characteristics of students and of educational experiences are allowed to interact in determining outcomes.

CHAPTER 2

SUPPLY AND DEMAND EFFECTS ON PART TIME WORK OF HIGH SCHOOL STUDENTS

Lawrence Hotchkiss

Introduction

There is mounting evidence that part time work during high school improves the employment prospects of noncollege bound youth just after they leave high school. Using the Youth in Transition data, Mortimer and Finch (in press) show substantial earnings gains during the first few years after high school to youth who worked while in high school. Analyzing the New Youth Cohort of the NLS, Lewis, Gardner, and Seitz (1983) find substantial reductions in unemployment after high school for noncollege youth who worked during high school at either a school supervised job (coop, work study) or a nonschool supervised job. Their findings apply to whites, blacks, females, and males. They do not, however, find large effects of working on wage or hours worked per week. Meyer and Wise (1981) find positive effects in the class of 1972 data of hours worked per week in high school on weeks worked and wage during each year in the first four years following high school. Ellwood (1981) examines the causal structure of the association between work during high school and later success in the labor market. He concludes that high school work experience does have positive effects, even after controlling for a number of variables that could be expected to affect work experience at both times. Stephenson (1981) estimates wage models of out-of-school youth in the NLS sample. He finds that employment before leaving school has positive wage effects for both black and white male youths. D'Amico and Baker (in press) also use the NLS data to examine effects of high school work on post high-school labor-market experience. They find that number of weeks worked and hours per week in the last year of high school reduce unemployment in the first year after leaving high school. This finding holds for blacks, whites, males, and females.

Although there is disagreement regarding the details of effects of working during high school on labor market outcomes in the first few years after high school, evidence from sufficient variety of data sets has accumulated so that one may be relatively secure that some positive benefits do, in fact, accrue. In contrast, there remains substantial doubt about effects of work during the high school years on other outcomes such as commitment to school, commitment to family, career expectations, and antisocial behavior. In groundbreaking work, Greenberger and her associates suggest that work while in high school is, at best, a mixed blessing (Greenberger and Steinberg 1981; Steinberg, Greenberger, Garduque, and McAuliffe 1982). Based on a local sample of several hundred youth in Orange county, California, Greenberger and her collaborators conclude that work contributes to development of a realistic view of the world of work, but it also reduces commitment to school and family, increases sinicism regarding work, and increases antisocial behaviors such as theft on the job and substance abuse. Mortimer and Finch (in press) find that working during high school depresses academic self concept, educational expectation, occupational expectation, academic performance, and educational attainment following high school.

In contrast, D'Amico and Baker (in press) find few undesirable side effects of working during high school. They find no important effects on academic performance, or on educational progress. In fact, they conclude that working increases the chance of completing high school; although, those who work during high school are found to be less likely to attend college. Hotchkiss (1982) examines effects of hours of work during high school on grades in school, participation in extracurricular activities, days absent from school, days tardy to school, educational expectation, and occupational expectation. Using linear specification of hours worked, a nonlinear specification including the square of hours worked, interaction of hours with job status, and controls for status background, he finds no effects of working, either positive or negative.

The extensive involvement of high school students in working at the same time they attend school is now well known. Greenberger and Steinberg (1981) trace the dramatic increase in the incedence of working in the last four decades. D'Amico and Baker (in press) summarize extensive documentation of this point. Lewis, Gardner, and Seitz (1983) report that many high school students work over 20 hours per week.

In brief summary, work during high school probably improves the employment prospects of noncollege youth in the first few years after leaving high school. It may also depress grades in school, educational and occupational expectations, and increase antisocial behaviors. But the evidence on these latter effects is contradictory. Finally, part time work during high school is experienced by over half of teenagers. Taken together, these findings indicate that it is important to undertake research designed to identify factors that influence work experience during high school.

The present study extends work reported by Hotchkiss, Bishop, and Gardner (1982), and the work of Hotchkiss (1984). The former study estimates cross-sectional models with High School and Beyond (HSB) data. The sample is comprised of the senior cohort, base year survey. Using a combined supply and demand model, the Hotchkiss-Bishop-Gardner study finds that several indicators of school quality do not influence hours worked per week during high school, wage, labor force participation, or unemployment. Having found little or no effects of school characteristics on employment in the previous study (Hotchkiss, Bishop, and Gardner, 1982), the present study focuses on school experiences that vary within schools and on attitudinal variables that may be influenced by schooling experiences. This chapter extends that work in two ways. First, the theoretical model based on the equilibrium assumption is revised to represent change over time and estimated using longitudinal data from the HSB. Secondly, operational indicators of commitment to work and to schooling are expanded.

The reason for the focus on schooling effects on employment stems from a general interest in effects of schooling on employability. It is in this sense that the present work is an extension of research reported by Hotchkiss (1984). That report investigates effects of schooling on 10 in-school outcomes purportedly related to employment after leaving school. These in-school outcomes include four standardized-test variables, educational expectation, occupational expectation, self esteem, locus of control, work values, and deportment in school. The relationship of the current study to the past work (Hotchkiss 1984) and to a broad view of the effects of schooling on employability is depicted schematically in figure 1. The prior work (Hotchkiss 1984) examines effects of socioeconomic background (SEB) and between-school differences on the in-school outcomes in figure 1.* The present study extends

*School experience is intended to include differences among school but not be limited to such differences.

this work by focusing on effects of schooling on the work outcomes. Other chapters in this report examine post high school work outcomes.

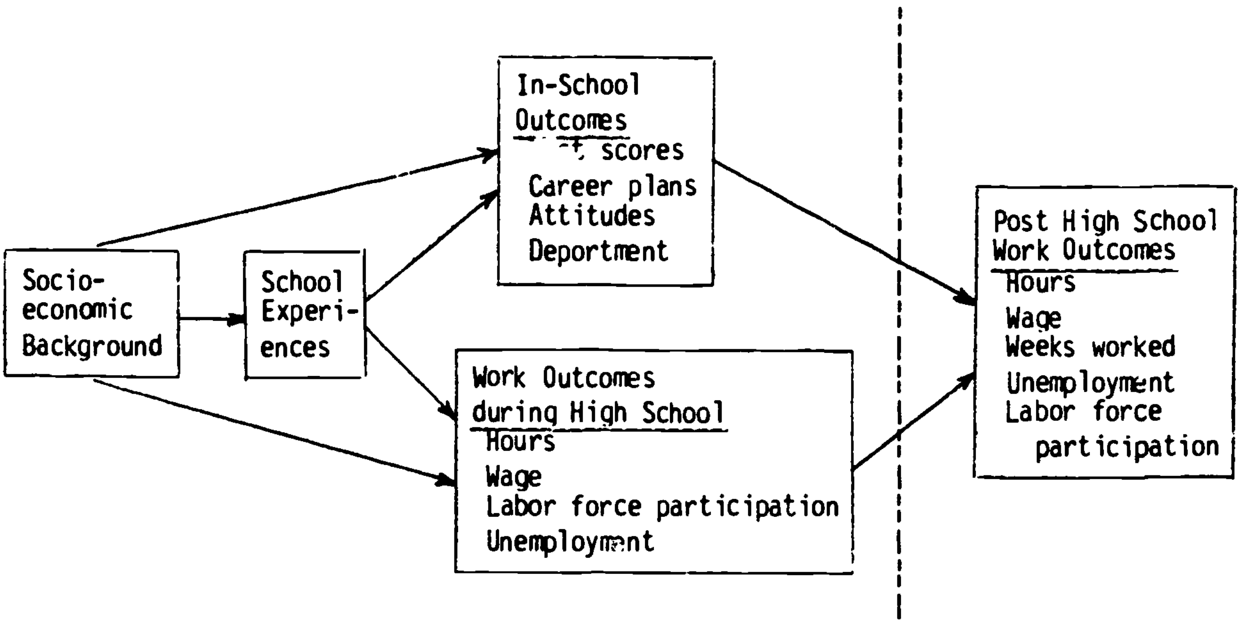

Figure 1. Schematic view of the process of unemployability development.

Theory

A large literature in economics treats the dual problems of supply and demand for labor (see Keeley (1981) for a review). Micro theory of labor supply applies a general optimizing model to the problem of individual choices regarding number of hours to work per unit of time. Macro theory of supply and demand for labor is based on the usual presumptions of positively sloping supply curve and negatively sloping demand curve--as wage increases supply of labor increases and demand decreases. Equilibrium occurs where the two curves cross. A number of challenges to this neo-classical theory have surfaced in the last several years, all based on presumptions of imperfect competition (Doeringer and Piore 1971; Kerr 1954; Bluestone 1970; Hodson and Kaufman 1982; Thurow 1975). While many of these challenges to traditional theory are thought provoking, they have not gelled into an internally consistent formalization that provides good grounding for empirical work (Cain 1976). While traditional theory is not fully adequate either, it provides a simpler basis as a starting point than do the alternatives. Consequently, the theoretical framework outlined here draws on traditional theory of labor-leisure choices and of supply and demand for labor.

Individual Labor Supply

The theory of individual labor supply is based on a utility model in which money income is balanced against leisure time to produce overall satisfaction or utility.* Each person selects the number of hours of leisure and money income subject to the constraint that there is a finite amount of time in a given period. As leisure increases, money income declines (and vice versa) because income is determined by multiplying wage by time at work, and time at work is the complement of leisure time. In mathematical notation, this simple model is written as follows:

(1a) Maximize: $U = f(L,\$)$;

(1b) Subject to: $\$ = w(T-L)$

where

U = utility,
f = the utility function,
L = leisure time,
$\$$ = earnings in the given period,
T = total amount of time in the period, and
w = wage.

Note that the constraint (1b) is just a statement of the fact that earnings per time period equal the wage multiplied by the number of time units (e.g., hours) worked. Since time in this simple model is divided into two categories, leisure and time at work, the amount of time at work is the complement of leisure--$H = T-L$, where H is time (hours) spent at work. Although the notation in (1) is found most commonly in the literature, it is convenient for present purposes to rewrite the model in the following terms:**

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*The theory in this section is an expansion of the equilibrium theory developed by Hotchkiss, Bishop, and Gardner (1982).

**The utility function f in (2a) is not the same function as the utility function in (1a). Since there is no need here to distinguish between the two functions, the same symbol is used twice in order to avoid proliferation of notation.

(2a) Maximixe: $U = f(L,H)$;

(2b) Subject to: $T = L+H$.

Several objections may be raised against this simplistic view of individuals' labor-leisure decisions: (1) Individuals seldom have complete control over the amount of time they work, yet the model implies that all external effects on time at work operate through wage adjustments. (2) The model excludes all nonmonetary incentives and disincentives to work. (3) At least for high school students, dividing time into two categories--work and leisure--is too simplistic. For students it is important to add a third category of time --time spent on school related activities. (4) As stated, the model is an equilibrium model; it gives no information about the process over time by which individuals adjust their work hours in order to achieve their maximum utility. Consequently, application of the model to longitudinal data is unspecified. (5) Since the functional form of the utility function f is unspecified, the model cannot be used to derive structural relations for empirical work that describe how hours at work depend on wage. (6) The model does not account for unearned income. (7) Finally, the model omits costs of entry into the labor market.*

There is no easy way to revise the model in order to accommodate the objection that individuals do not control fully the number of hours they work. It should be noted, however, that all persons exercise partial control over the time spent at work by changing jobs until they find one with the number of hours that suits them. Also, some people exercise partial control by working overtime, getting substitute workers, and informal bargaining with their shift supervisors. High school students undoubtedly are more capable of adjusting the amount of time they work through these latter mechanisms than is the general population.

There are ways to revise the model to accommodate objects 6 and 7, but the added complexity of these expansions more than offsets the gain, for present applications.

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*See Keeley (1981) for a review of some of these points, and Hotchkiss, Bishop, and Gardner (1982) for additional discussion of them.

The second, third, fourth and fifth objections to the model are relatively easy to remedy and are critical to the present investigation. In the revised model, to be presented momentarily, time is divided into three segments--leisure, work and school. Nonmonetary as well as monetary rewards of work are incorporated into the model. A dynamic form of the model is postulated. And, a specific functional form of the model is specified. All these features except the dynamic specification are incorporated into the following utility model. The dynamic specification is added subsequently. The static model is--

(3a) Maximize: $U = aL - \frac{1}{2}L^2 + (b_1w+b_2x)H - \frac{1}{2}H^2 + czS - \frac{1}{2}S^2$;

(3b) Subject to: $T = L+H+S$,

where

U = utility,
L = leisure time,
H = work time,
S = school time,
T = total time in the period,
w = wage,
x = nonmonetary satisfactions of work,
z = valuation placed on schooling,
a, b_j, c = empirical constants, all positive.

The solution to this maximization problem gives the following equation describing the dependence of time at work (H) on the other variables in the utility function--

(4) $H = \frac{1}{3}(T-a) + \frac{2}{3}b_1w + \frac{2}{3}b_2x - \frac{1}{3}cz$

This is a linear model of the following general form:

(4a) $H = a^* + b_1^*w + b_2^*x + c^*z$

with the coefficients marked by asterisks given the obvious definitions.

Thus, the model for time at work given in (3) implies that the number of hours one chooses (prefers) to work depends positively on wage and nonmonetary rewards of work and negatively on valuation placed on schooling. These results are sensible, but they still do not account for the process by which individuals adjust their hours in order to achieve the optimum number. To describe that process assume that the value of H given in (4a) is the equilibrium value and rechristen it H*. Then a partial adjustment model can be applied to describe how individuals change their hours in a manner that will lead them ultimately to work H* hours, the number that maximizes their utility. The partial adjustment model is written as follows:

$$(5) \quad \frac{dH}{dt} = q(H-H^*)$$

$$(5a) \quad \frac{dH}{dt} = q(H-a^*-b_1^*w-b_2^*x-c^*z)$$

where dH/dt is the derivative of H with respect to time (instantaneous change rate), and q is a negative constant. The idea expressed here is that in each very short time interval (dt is a limiting value of Δt as Δt approaches zero) individuals adjust their actual hours worked (H) toward the equilibrium value (H*) that will maximize their utility. Assuming $-1 < q < 0$, the adjustment in each short interval is less than the full amount required to achieve the optimum (H*); hence, the model is termed partial adjustment.

The differential equation in (5) is not satisfactory for empirical work because the dependent variable (dH/dt) is an instantaneous rate of change and cannot be observed. Consequently, it is necessary to integrate (5) in order to find an expression that can be used in observational work. In carrying out the integration, however, it is important to note that the independent variables in (5)--wage, nonmonetary rewards of work, and valuation placed on schooling may, themselves, be dependent on hours. Certainly, one of the key predictions of human capital theory is that wage depends on past work experience (Becker 1975; Mincer 1974). Hence, we expect change in wage to depend on hours (H). Similarly, it is likely that nonmonetary satisfactions of work and valuation on school depend on wage, hours, and on each other (Greenberger and Steinberg, 1981). The end result of these multiple interdependencies is a system of differential equations. If a linear form with constant coefficients is imposed on each of these equations, a system of cross-lagged linear equations results from simultaneous integration of the system (Coleman 1968; Doreian and Humman 1976, Hotchkiss 1979; Arminger 1983). For the variables of interest here, one has--

$$H_2 = \alpha_H + \beta_{HH}H_1 + \beta_{Hw}w_1 + \beta_{Hx}x_1 + \beta_{Hz}z_1$$

$$(6) \quad w_2 = \alpha_w + \beta_{wH}H_1 + \beta_{ww}w_1 + \beta_{wx}x_1 + \beta_{wz}z_1$$

$$x_2 = \alpha_x + \beta_{xH}H_1 + \beta_{xw}w_1 + \beta_{xx}x_1 + \beta_{xz}z_1$$

$$z_2 = \alpha_z + \beta_{zH}H_1 + \beta_{zw}w_1 + \beta_{zx}x_1 + \beta_{zz}z_1$$

where the subscripts on the variables (H, w, x, z) indicate time.

A key result of economic theory of labor supply is that wage has a positive effect on labor supply, i.e., the amount of time individuals desire to spend at work. An equally venerable result of aggregate supply and demand theory is that wage has a negative effect on the demand for labor time. If the aggregate relation is assumed to derive from the addition of individual-level relations, then with certain assumptions about interpersonal independence of utility functions, the conclusion about the negative impact of wage on demand for labor also applies at the individual level. Since data are available only for amount of time actually spent working, it is difficult to disentangle the supply and demand effects.

Similar ambiguity arises with respect to nonwage variables in the supply equations; viz, they may also affect demand. In the case of nonmonetary rewards of work, however, the supply and demand effects should operate in the same direction. Those who derive psychic benefits from work are likely to desire to work more hours than those who do not, and employers are likely to demand more time from them because they are more productive. On the other hand, the supply and demand effects of valuation placed on schooling should operate in opposite directions. As derived from the utility model, supply effects should be negative. But employers are likely to value employees who have a strong commitment to school, on the hypothesis that commitment to school generalizes to responsible attitudes and behaviors at work. Hence, the demand effect of valuation on schooling should be positive.

Variables other than those incl ded in the supply theory undoubtedly influence demand. The theory that demand is determined primarily by wage depends on the assumptions of a competitive market. In a competitive market, the "price" of labor (wage) fluctuates freely in response to supply and demand forces, leading to an equilibrium wage that will clear the market, i.e., eliminate unemployment. In fact, however, large firms exercise significant control over wages they pay, and workers influence the wage they receive through unions and individual bargaining. For high school students, however, the wage generally is given, since they have little power through unions or other devices to influence it. While teen-age youth may in theory influence the wage they receive by shopping for jobs with a high wage, the persistently high rate of unemployment among youth renders this strategy relatively ineffective.

Thurow (1975) argues that productivity resides mostly in jobs rather than individuals, because most jobs are designed so that their tasks can be carried out by many different incumbants. Most jobs do require some training, however, so that employers are motivated to minimize training costs. In a labor market with high unemployment they therefore can select employees who they believe will keep training costs down. Since it is difficult and expensive to determine in advance the cost of training different prospective employees, Thurow argues that employers make use of very rough proxies, including race, ethnicity, gender, and socioeconomic background. Employers' desire to have workers who are responsible--show up on time, work hard, don't steal or vandalize company property--also must motivate them to be selective in their hiring practices. Again, the difficulty of predicting responsible behavior on the job creates pressure on employers to use rough proxies.

There are two aspects of differences among schools youth attend that may influence the demand for their services in the labor market. First, as argued by Hotchkiss, Bishop, and Gardner (1982), employers may use a school's reputation in the local community as an indicator of how desirable a student in the school will be as an employee. Hotchkiss, Bishop, and Gardner failed to support this hypothesis using the senior cohort of the HSB and cross-sectional analysis. They agrue that the labor markets for high school youth may not span enough school attendance areas to make it feasible for employers to use school reputation as a basis for selecting teenage employees. Nevertheless, their measures of school reputation are rough proxies, and their data are cross sectional.

A second and potentially more important aspect of differences among schools that may influence demand for high school students in the labor market is the fact that local economies in the geographic area where schools are located vary in their aggregate demand for labor. For both of these reasons, a useful device for studying work experience of high school students is to utilize dummy variables to represent school effects, or, equivalently, carry out statistical analyses by deviating each variable from its corresponding school mean. School effects are removed from the models estimated in this paper, but little emphasis is placed on interpreting significant differences between schools due to the ambiguities associated with those differences.

To add one more complicating factor, it is possible that schools influence supply of labor as well as demand. Schools may foster tastes and attitudes that enter directly into the supply equations. If controls for the appropriate tastes and attitudes are included, however, direct effects of schools on supply should be reduced.

In summary, what we have is several collections of variables that may affect both supply and demand for labor. The prospect for precisely separating the two types of effects without conducting controlled, experiments appears grim. It is possible that a very rough approximation may be achieved by the following device: Consider hours worked per week and decision to enter the labor market as primarily determined by individuals, and interpret wage and unemployment as determined by employers. With these interpretations, hours and labor-force participation equations can be viewed as supply equations, and wage and unemployment equations as demand equations (Hotchkiss, Bishop, and Garnder 1982). The rationale for these interpretations are as follows: Youth have considerable lattitude in determining the hours they work. First, they may shop for a job that offers the number of hours that suits them. Secondly, they may negotiate on a weekly basis with shift supervisors to set the number of hours they work. Finally, they may substitute for other company employees or get someone to substitute for them. These tactics appear to be fairly common among high school workers. On the other hand, wages are attached to jobs and generally follow a fixed schedule of increments controlled almost entirely by employers. Decisions to enter the labor market are made by individuals, and unemployment is by definition involuntary.

Hence, labor force participation and unemployment may b the purest supply and demand variables, respectively, of those available.

Analysis

The statistical analysis is based on equation system (6), except that equations in which nonmonetary rewards of work and valuation of schooling are dependent variables are not reported. These equations are omitted due to the focus of this paper on variables describing work experience. Since labor-force participation and unemployment are important aspects of work experience and they probably present purer separation of supply and demand effects, equations in which they appear as dependent variables are estimated.

The dynamic model in (5) leads to a sequence of regressions in which the time-2 measure of each outcome variable appears as a dependent variable, and its lagged value is included as one of the regressors. Ordinary least-squares (OLS) regression analysis is used to calculate estimates of effects. As is well known, OLS produces biased coefficient estimates when regressors are correlated with the distrubance in a given equation. Nonzero correlation between regressors and the disturbance may be likely in equations such as (6) because they include lagged value of the dependent variable (Hannan and Young 1977). However, with only 2 waves of data, there does not appear to be an easy method to correct for the bias (see, however, Arminger 1983 for discussion of non OLS estimation).

Binary dependent variables such as labor-force participation and unemployment when analyzed by OLS may produce inefficient estimates (Judge et al. 1980), but alternative methods of analysis such as probit or logit are relatively expensive with large samples such as the High School and Beyond to be analyzed here. Further, with a large sample inefficient estimation is not as serious as would be the case with a small sample. Consequently, OLS estimates are reported.

The calculations were carried out by inputting a correlation matrix based on the pairwise deletion method to the regression procedure in SAS. This method appears to produce the most efficient estimating procedure of the practical algorithms available (see Kim and Curry 1977; Hertel 1976). In some cases, as noted in the next section of this paper, missing data dummies were included.

In the case of 2 sets of variables--nonmonetary rewards of work and an attitudinal subset of indicators of valuation on schooling--restricted OLS regression is used to combine the several indicators into a single index. The strategy is to use the restrictions to determine the standardized regression coefficient for an index composed of variables whose coefficients are subject to the restrictions. In the present case it was assumed that the index was constructed by dividing each component by its standard deviation and then adding-- $I = x_1/s_1 + \ldots + x_K/x_K$, where I is the index value, x_i are items, and s_i are their corresponding standard deviations. The standardized coefficient on I can be read as the standardized coefficient on any one of the x_i <u>multiplied by the standard deviation of the index</u>, under the following restrictions:

$$s_1b_1 - s_2b_2 = 0$$

$$s_1b_1 - s_3b_3 = 0$$

$$\vdots \qquad \vdots$$

$$s_1b_1 - s_Kb_K = 0$$

There are 2 main advantages to this procedure. First, tests of the restrictions are standard output of regression packages such as SAS. Hence, one does not need to assume that the (standardized) regression coefficients on all members of the index are constant, one can test for it. Secondly, an index can, in effect, be created from a correlation matrix input to the regression program; it is not necessary to calculate the index value for each case in the sample. Large savings in computing cost and time therefore may result. The primary disadvantage is that the standard deviation of the index must be calculated in order to compute the standardized regression coefficient associated with the index. Since the standard deviation of the sum of K standardized values is the square root of the sum of the K^2 elements in the matrix of intercorrelations among those items, however, it is unnecessary to obtain any calculations from the raw input data.

Data and Variables

The sample for this study consists of the base year and first follow-up surveys of the Sophomore cohort of the High School and Beyond (HSB).* The sample includes 30,030 youth attending over 1,000 U.S. high schools in 1980. These same individuals were resurveyed in 1982 when they were seniors in high school, porviding they progressed at the modal rate. Respondents who dropped out of school and those who did not participate in both the base-year and first follow-up surveys are excluded from the analysis, leaving 24,697 youth in the sample. For the analyses in which hours and wage (t_2) are dependent variables, those who reported at first follow-up that they had never worked also were excluded, leaving 20,144 cases. For the unemployment equation, those determined to be out of the labor force at first follow-up, school dropouts, and those not participating in either the base-year or first follow-up survey were excluded from the regressions, leaving 17,688 cases for analysis of unemployment.** Those not in the labor force were excluded from the unemployment equations so that those equations would more nearly reflect demand considerations. The only cases excluded from the labor-force participation equations are school dropouts and those who did not participate in the base year or first follow-up surveys.

It is important to note that respondents who reported never having worked in the base-year survey were not excluded from any of the analyses. Rather, three dummy variables were constructed to account for missing hours and wage information in the base year: (1) a missing-data dummy for hours (t_1), (2) a missing data dummy for wage (t_1), and (3) a dummy variable representing never having worked in the base year. These 3 dummy variables were included on the right side of every equation, but their values are not tabulated. Their coefficients generally are small, but their inclusion has a marked impact on some of the other coefficients.

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

**Those with missing data on the labor-force participation variable were excluded.

The data are comprised of questionnaire responses to both waves of the survey and test scores of academic achievement, also administered at both waves. The first follow-up questionnaires repeat most of the items on the base-year questionnaires. The tests used for first follow-up are the same tests used in the base year.

The four dependent variables analyzed in this paper are defined as follows:

- Hours--hours worked per week, as reported by respondents for current or most recent job. Hours were reported in broad ranges; numeric scores were assigned at the midpoint of those ranges.

- Wage--wage on the current or most recent job, as reported by respondents. Wage also was collected using a set of dollar ranges. The codes for each range were converted to the dollar value of the midpoint of the range.

- Labor force participation--a dummy variable: 1 = in the labor force (either working or looking for work); 0 = not in the labor force.

- Unemployment--a dummy variable: 1 = unemployed (in the labor force but not working); 0 = employed. (Those not in the labor force were excluded from the analysis of unemployment.)

Measures of each of these four variables are used from the base year and first follow-up surveys. The time-2 measures are dependent variables in the regressions, and the corresponding time-1 measure is included among the regressors. Additionally, lagged wage is used to predict current hours, unemployment, and labor force participation. Lagged hours also are used as predictors of current wage, labor-force participation, and unemployment.

The fact that the hours and wage data were collected for current or most recent job reduces complexities due to selection bias. If wage and hours data were not available for those who were not working at the time of the surveys, then selection bias might seriously flaw the OLS estimates of effects (Heckman 1976).

The independent variables are classified into several types: (1) nonmonetary rewards to work, (2) valuation on schooling, (3) career expectations, (4) curriculum track, (5) personal characteristics and socioeconomic background (SEB), (6) test scores, (7) past work experience, and (8) unearned income. The first two types, along with wage are, according to the theory, primary determinants of labor supply. Career expectations also are included on the grounds that they are good indicators of value placed on schooling. The personal characteristics and SEB are included primarily as determinants of demand, but they may also affect traits that influence supply. The test scores and past work experience are included as indicators of accumulated human capital. The two primary indicators used in studies of adults are years of education and years of experience. Since all members of the sample have accumulated the same number of years of education the test scores are used instead of years of schooling.

Specific variables included in each of the seven categories are defined as follows:

- Nonmonetary rewards of work
  - Work values--a 4-item index. The items include opinions about (1) importance of steady work, (2) importance of earning money, (3) importance of being successful in one's work, and (4) importance of leisure (reflected). Each item has three response options: not important to very important. High values on the index indicate work is important.
  - Work just for money--respondent agreement (yes, or no) with the view that one works only to earn money. Agreement indicates little or no nonmonetary rewards of work.
  - Work more enjoyable than school--respondent agreement (yes, no) that work is more enjoyable than school. Agreement indicates high nonmonetary rewards of work.
  - Job encourages good work habits--respondent agreement (yes, no) that working for pay encourages good work habits. Agreement is interpreted to indicate higher nonmonetary rewards of work than disagreement.
  - Enjoy working for pay--respondent agreement (yes, no) that he or she enjoys working for pay. Agreement is interpreted to indicate higher nonmonetary rewards of work than disagreement.

Some of these items are more closely related in their construction to the idea of nonmonetary rewards of work than others. But they all indicate a general positive (or negative) valence toward working; hence, they should as a group provide rough indication of nonmonetary rewards of work. In the data analyses these 5 indicators of nonmonetary rewards of work are combined into a single index by use of the restricted OLS procedure described earlier.

- Valuation on schooling
  - Satisfied with school--respondent agreement (true, false) that he/she is satisfied with his/her education. Agreement indicates higher valuation on schooling than disagreement.
  - Interested in school--respondent agreement (true, false) that he/she is interested in school. Agreement indicates higher valuation on schooling than disagreement.
  - Like working hard in school--respondent agreement (true, false) that he/she likes to work hard in school. Agreement indicates higher valuation on schooling than disagreement.
  - School problems index-- 6 item index. The items include (1) student respondent report that students don't attend school, (2) respondent report that students cut classes, (3) respondent report that students talk back to teachers, (4) respondent report that students don't obey teacher instructions, (5) respondent report that students fight among themselves, and (6) respondent report that students attack teachers. Respondents were asked to indicate whether each of these behaviors was a problem in the school. Three response alternatives were used from often happens to rarely or never. High values on this index are interpreted to indicate low valuation on school.
  - School rating index--a 7 item index. The items are: (1) rating of the quality of the school building, (2) rating of the quality of the library, (3) rating of the quality of academic instruction, (4) rating of the school reputation in the community, (5) rating of teacher interest in students, (6) rating of effectiveness of school discipline, and (7) rating of the fairness of school discipline. All ratings were done on a 4 point scale ranging from poor to excellent. High values on the index are interpreted to be indicative of high valuation on school.
  - Job more important than school--respondent agreement (yes, no) that working for pay is more important than school. Agreement indicates low valuation on schooling. This item could also be indicative of nonmonetary rewards of work, but the wording more closely approximates value placed on schooling (or work) than nonmonetary rewards of work, despite the reversal in the wording of the item.
  - Attitudes toward English and math courses-- 8 item scale. Respondents were asked to indicate whether the following statements were true or false for English and for math: (1) at ease in English/math class, (2) feel tense in English/math class, (3) English/math scares me, (4) dread English/math class. The items in this group with which agreement indicates a negative attitude toward English or math were reflected prior to calculating the index value. High values on the resulting index therefore indicate high value placed on school.

- Not safe in school--respondent agreement (true, false) with a statement that he or she does not feel safe at "this school." Agreement is interpreted to indicate low value placed on school.

The above 8 indicators of valuation on schooling all are attitudinal in nature. In the analyses that follow they are combined into a single index of attitudes toward school by use of restricted OLS, as described in the section on analysis.

- Discipline problems in school--respondents' self report of discipline problems in school. Two response options were used (true, false). Agreement with the statement indicates low value placed on school.
- Suspended from school--respondents' self report of whether he/she had been suspended or on probation from school. A true-false response format was used. Agreement indicates low valuation on school.
- Cutting class--respondents' self report of cutting class periodically. A true-false response format was used. Agreement is interpreted to indicate low valuation placed on schooling.
- Absent from school--days absent from school but not sick, as reported by respondent. Data were collected using ranges of days absent. The variable was recoded to the midpoint of each range. Large number of days absent is interpreted to be indicative of low value placed on school.
- Late to school--days late to school, as reported by the respondent. Data were collected using ranges of days tardy. The variable was recoded to the midpoint of each range. Large number of days tardy is interpreted as indicative of low valuation on school.
- Number of extracurricular activities--count of number of extra curricular activities, as reported by the respondent; maximum = 12. Large number of extracurricular activities are interpreted to be indicative of high value placed on school.

• Career expectations
  - Educational expectation--approximate number of years of schooling respondent expects to complete.
  - Occupational expectation--status level of the broad occupational group which the respondent expects to achieve. Average Duncan SEI scores for each of 14 occupational categories were used.

The variables classified as "valuation on schooling" and as "career expectations" are interpreted as rough indicators of the underlying conception--how much does a youth value his/her schooling experience. Most of these measures give only indirect indication of valuation on schooling; hence, they are less than ideal. Absence of more direct measures in the data, however, forces reliance on indirect measures. Even if direct questions were available asking respondents to rate the importance of their schooling, one might argue that behavioral and other indirect evidence ought also to be used. One who shows high commitment to school by his or her behavior and expresses high career expectations, it is presumed here, demonstrates high value placed on school.

- Curriculum track
  - Academic track--respondent report of whether pursuing a college preparatory curriculum (1 = yes, 0 = no).
  - Vocational track--respondent report of whether pursuing a vocational curriculum (1 = yes, 0 = no).
- Personal characteristics and SEB
  - Gender-- 1 = female, 0 = male
  - Race-- 1 = black, 0 = not black
  - Ethnicity-- 1 = Hispanic, 0 = not Hispanic
  - Father's occupation--status of father's occupation, measured by youth's report using 14 broad occupational categories. The average Duncan SEI score for each occupational category was assigned to indicate status.
  - Father's education--approximate number of years of education of respondent's father, as reported by the youth.
  - Mother's occupation--status of mother's occupation, measured by youth's report using 14 broad occupational categories. The average Duncan SEI score for each occupational category was assigned to indicate status.
  - Mother's education--approximate number of years of education completed by respondent's mother, as reported by the youth.
  - Number of siblings--number of brothers and sisters that respondent reported having.
  - Father out of household--father or male guardian <u>not</u> living in the household (1 = out, 0 = in).
  - Mother out of household--mother or female guardian <u>not</u> living in the household (1 = out, 0 = in).
  - Log of family income--income of respondent's family was reported by the youth in broad income ranges. Codes for each range were converted to midpoint values, and then logarithms were taken.

- Possessions in the home--number of possessions out of a list of 9 that the youth reported having in his/her home. The list includes newspaper delivered, encyclopedia, typewriter, electric dishwasher, 2 or more cars or trucks, 50 or more books, own room, and a pocket claculator.
- Home ownership--whether parents owr their home, as reported by the youth (1 = yes, 0 = no).
- Number of rooms in home--number of rooms in respondent's home, as reported by the youth.

Missinq-data dummy variables were used in conjunction with both parent's education and occupation and family income. Their coefficients are not tabulated, however.

- Test scores
  - Verbal test score--average of 3 tests each with $\bar{x} = 50$, SD = 10. The 3 tests covered writing, vocabulary, and reading.
  - Math test score--average of 2 tests each with $\bar{x} = 50$, SD = 10.
  - Science test score--science test score, $\bar{x} = 50$, SD = 10.
  - Civics test score--civics test score, $\bar{x} = 50$, SD = 10.
- Past work experience
  - Hours worked last summer--hours worked per week in the summer prior to the senior year, reported in broad ranges and converted to midpoint values.
  - Hours worked last school year--hours worked per week in the previous school year, reported in broad ranges and converted to midpoint values.
- Unearned income
  - Parents give youth money--youths report of whether he/she receives spending money (1) as a regular allowance, (2) when need it, or (3) not at all.

Findings

Table 2.1 through table 2.4 display effect estimates in the equations for which hours worked per week in the senior year, wage in the senior year, labor force participation in the senior year, and unemployment in the senior year, respectively, are the dependent variables. These estimates were calculated under the restrictions noted previously on the indicators of nonmonetary rewards of work and on the indicators of valuation placed on school. Estimates

TABLE 2.1

ESTIMATES OF COEFFICIENTS FOR HOURS EQUATION
(Dependent variable = hours worked per week, time 2)

Independent Variables (All lagged or exogenous)	No Control for between School Differences		Control for between School Differences	
	Standardized Coefficient	Unstandardized Coefficient	Standardized Coefficient	Unstandardized Coefficient
Hours/week, sophomore year	.1019***	.0942	.0898***	.0821
Hours/week, last summr	.2056***	.1446	.1970***	.1391
Hours/week, last school year	.2334***	.2070	.2169***	.1921
Wage	-.0006	-.0049	-.0076	-.0592
Nonwage work rewards	.0058	.0249	.0152+	.0625
Valuation on school	.0023	.0063	.0003	.0009
Discipline problems in school	.0025	.0738	.0009	.0255
Suspended from school	-.0090	-.3259	-.0063	-.2261
Cut classes at school	.0316***	.7836	.0262**	.6734
Days absent from school	.0174*	.0532	.0218*	.0666
Days late to school	-.0020	-.0058	-.0021	-.0063
No. of extra curricular act.	-.0301***	-.1337	-.0259**	-.1131
Educational expectation	.0021	.0091	-.0065	-.0288
Occupational expectation	-.0316***	-.0156	-.0324***	-.0160
Academic track	-.0052	-.1170	-.0015	-.0354
Vocational track	.0215*	.6102	.0162*	.4824
Verbal test score	-.0195	-.0244	-.0155	-.0211
Math test score	-.0257*	-.0304	-.0169	-.0216
Science test score	-.0119	-.0132	-.0091	-.0110
Civics test score	.0058	.0064	.0086	.0099
Gender (1=female)	-.0181*	-.3941	-.0234*	-.5153
Race (1=black)	-.0161*	-.5229	-.0343***	-1.4573
Ethnicity (1=Hispanic)	.0167*	.5145	.0045	.1633
Father's occupation	.0240*	.0113	.0124	.0061
Father's education	-.0874***	-.1971	-.0800***	-.1867
Mother's occupation	.0179	.0075	.0048	.0020
Mother's education	-.0287	-.0830	-.0134	-.0391
Number of siblings	-.0050	-.0254	.0004	.0021
Father not in household (1=out)	.0204*	.6075	.0208*	.6212
Mother not in household (1=out)	.0114	.5759	.0099	.4892
Log of family income	.0797***	1.0231	.0696***	.9036
Number of possessions	-.0074	-.4036	-.0078	-.4509
Home ownership (1=yes)	-.0211*	-.5749	-.0156*	-.4385
Number of rooms in home	-.0028	-.0157	.0169*	.1037
Receive money from parents	.0064	.1106	.0007	.0115

Adjusted partial r for school effects = .0008.
Corresponding F-ratio = 1.014. N.S.

+ p ≤ .05
* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.
(2-tailed test)

TABLE 2.2

ESTIMATES OF COEFFICIENTS FOR WAGE EQUATION
(Dependent variable = wage per hour, time 2)

Independent Variables (All lagged or exogenous)	No Control for between School Differences: Standardized Coefficient	No Control for between School Differences: Unstandardized Coefficient	Control for between School Differences: Standardized Coefficient	Control for between School Differences: Unstandardized Coefficient
Hours/week, sophomore year	.0037	.0003	.0062	.0005
Hours/week, last summer	.1222***	.0072	.1155***	.0066
Hours/week, last school year	.0445***	.0033	.0329***	.0024
Wage	.2622***	.1740	.2245***	.1413
Nonwage work rewards	.0117	.0505	.0212*	.0874
Valuation on school	.0093	.0250	.0117	-.0308
Discipline problems in school	-.0058	-.0142	-.0077	-.0181
Suspended from school	-.0020	-.0060	-.0016	-.0045
Cut classes at school	.0261**	.0540	.0168*	.0349
Days absent from school	.0136	.0035	.0174*	.0043
Days late to school	.0240*	.0059	.0084	.0020
No. of extra curricular act.	-.0363	-.0134	-.0141*	-.0050
Educational expectation	.0126	.0045	-.0010	-.0003
Occupational expectation	.0008	--	-.0039	-.0002
Academic track	.0171*	.0323	.0074	.0146
Vocational track	.0184*	.0437	.0150*	.0361
Verbal test score	-.0096	-.0010	-.0254*	-.0028
Math test score	.0242*	.0024	.0229*	.0024
Science test score	-.0127	-.0012	.0051	.0005
Civics test score	-.0025	-.0002	.0026	.0002
Gender (1=female)	-.1085***	-.1975	-.1223***	-.2189
Race (1=black)	.0215*	.0584	-.0009	-.0030
Ethnicity (1=Hispanic)	.0280**	.0719	.0056	.0163
Father's occupation	.0187	.0007	.0025	.0001
Father's education	.0370*	.0070	-.0054	-.0010
Mother's occupation	.0036	.0001	-.0105	-.0004
Mother's education	.0081	.0020	-.0165	-.0039
Number of siblings	-.0052	-.0022	-.0019	-.0008
Father not in household (1=out)	.0114	.0264	.0004	.0010
Mother not in household (1=out)	-.0050	-.0213	-.0038	-.0151
Log of family income	.1800***	.1928	.1085***	.1142
Number of possessions	.0509***	.2302	.0450***	.2110
Home ownership (1=yes)	-.0142	-.0323	-.0012	-.0028
Number of rooms in home	-.0349***	-.0166	-.0001	--
Receive money from parents	-.0095	-.0136	-.0056	-.0076

Adjusted partial r for school effects = .2127.
Corresponding F-ratio = 1.8412. p ≤ .0001.

* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.
(2-tailed test)

TABLE 2.3

ESTIMATES OF COEFFICIENTS FOR LABOR-FORCE PARTICIPATION EQUATION
(Dependent variable = labor-force participation, time 2)

Independent Variables (All lagged or exogenous)	No Control for between School Differences		Control for between School Differences	
	Standardized Coefficient	Unstandardized Coefficient	Standardized Coefficient	Unstandardized Coefficient
Labor-force participation	.1451***	.1258	.1305***	.1128
Hours/week, sophomore year	-.0256**	-.0009	-.0152*	-.0005
Hours/week, last summer	.0890***	.0024	.0929***	.0026
Hours/week, last school year	.1276***	.0044	.1233***	.0043
Wage	-.0151	-.0046	-.0131	-.0039
Nonwage work rewards	.0240***	.1033	.0257***	.1057
Valuation on school	-.0024	-.0065	-.0012	-.0031
Discipline problems in school	-.0073	-.0084	-.0050	-.0057
Suspended from school	-.0066	-.0096	-.0086	-.0122
Cut classes at school	.0183*	.0181	.0118	.0122
Days absent from school	-.0141*	-.0017	-.0112	-.0014
Days late to school	.0138*	.0016	.0085	.0010
No. of extra curricular act.	.0077	.0013	.0203*	.0035
Educational expectation	-.0200*	-.0034	-.0184*	-.0032
Occupational expectation	-.0104	-.0002	-.0092	-.0002
Academic track	-.0091	-.0081	-.0148*	-.0143
Vocational track	.0222*	.0250	.0156*	.0184
Verbal test score	-.0208	-.0010	-.0123	-.0007
Math test score	.0072	.0003	.0005	.00004
Science test score	.0101	.0004	.0101	.0005
Civics test score	.0059	.0003	-.0005	-.00002
Gender (1=female)	.0250**	.0215	.0206*	.0181
Race (1=black)	-.0165*	-.0200	-.0187*	-.0303
Ethnicity (1=Hispanic)	-.0326***	-.0386	-.0118	-.0165
Father's occupation	.0263*	.0005	.0128	.0003
Father's education	-.0368*	-.0032	-.0354*	-.0032
Mother's occupation	.0017	.00003	.0002	--
Mother's education	-.0450*	-.0051	-.0369*	-.0042
Number of siblings	.0018	.0003	.0002	.00004
Father not in household (1=out)	.0026	.0031	-.0021	-.0024
Mother not in household (1=out)	-.0136*	-.0264	-.0117	-.0222
Log of family income	-.0042	-.0021	-.0336*	-.0174
Number of possessions	.0300***	.0629	.0222*	.0501
Home ownership (1=yes)	.0070	.0074	.0065	.0071
Number of rooms in home	-.0010	-.0002	-.0045	-.0011
Receive money from parents	.0016	.0011	.0014	.0009

Adjusted partial r for school effects = .1395.
Corresponding F-ratio = 1.458. p ≤ .0001.

* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.
(2-tailed test)

TABLE 2.4

ESTIMATES OF COEFFICIENTS FOR UNEMPLOYMENT EQUATION
(Dependent variable = unemployment, time 2)

Independent Variables (All lagged or exogenous)	No Control for between School Differences		Control for between School Differences	
	Standardized Coefficient	Unstandardized Coefficient	Standardized Coefficient	Unstandardized Coefficient
Unemployment	.0351***	.0360	.0359***	.0364
Hours/week, sophomore year	.0321***	.0010	.0277**	.0009
Hours/week, last summer	-.1182***	-.0030	-.1115***	-.0028
Hours/week, last school year	-.0699***	-.0022	-.0624***	-.0019
Wage	-.0020	-.0006	-.0031	-.0008
Nonwage work rewards	-.0403***	-.1731	-.0351***	-.1442
Valuation on school	-.0126	-.0339	-.0148	-.0390
Discipline problems in school	.0148	.0152	.0126	.0128
Suspended from school	.0042	.0054	.0046	.0058
Cut classes at school	-.0167*	-.0145	-.0100	-.0091
Days absent from school	.0152	.0017	.0129	.0014
Days late to school	.0054	.0006	.0015	.0002
No. of extra curricular act.	.0129	.0020	.0053	.0008
Educational expectation	.0057	.0009	.0041	.0006
Occupational expectation	.0211*	.0004	.0171*	.0003
Academic track	.0041	.0032	-.0041	-.0035
Vocational track	-.0124	-.0122	-.0154	-.0159
Verbal test score	.0222	.0010	.01[illegible]	.0008
Math test score	-.0203	-.0008	-.0175	-.0008
Science test score	-.0051	-.0002	-.0013	-.0001
Civics test score	.0047	.0002	.0015	.0001
Gender (1=female)	-.0274*	-.0209	-.0201*	-.0156
Race (1=black)	.0843***	.0930	.0647***	.0953
Ethnicity (1=Hispanic)	.0252*	.0272	.0132	.0168
Father's occupation	-.0140	-.0002	-.0046	-.0001
Father's education	.0408*	.0034	.0408*	.0035
Mother's occupation	-.0218	-.0003	-.0153	-.0002
Mother's education	.0013	.0001	.0017	.0002
Number of siblings	-.0071	-.0013	-.0065	-.0011
Father not in household (1=out)	-.0122	-.0126	-.0073	-.0076
Mother not in household (1=out)	.0145	.0258	.0160*	.0280
Log of family income	-.0294*	-.0144	-.0241	-.0120
Number of possessions	-.0246*	-.0468	-.0129	-.0264
Home ownership (1=yes)	-.0058	-.0055	-.0033	-.0032
Number of rooms in home	-.0073	-.0015	-.0132	-.0028
Receive money from parents	.0282**	.0168	.0189*	.0112

Adjusted partial r for school effects = 0.
Corresponding F-ratio = .930. N.S.

* p ≤ .01.
** p ≤ .001.
*** p ≤ .0001.
(2-tailed test)

in each table are shown for one equation for which the school dummy variables were omitted and for one equation including the school dummies. The adjusted partial correlation indexing between-school effects is shown at the bottom of each table along with results of the F test for significance of differences among schools.

The pattern of effects for the variables that are included in the theoretical model of labor supply is quite interesting indeed. The most startling finding is that lagged wage has no significant effect in either the hours equation or the labor-force participation equations. The coefficients exhibit the "wrong sign" in the labor-force participation equations but are not statistically significant. This may be due in part to the countervailing influences of supply and demand effects of wage, but to the extent that the hours and labor-force participation equations reflect supply, as argued above, this interpretation is untenable. As will be noted presently, however, the data reveal some indirect evidence that both supply and demand factors influence hours and labor-force participation.

The use of lagged wage in the hours equation (and vice versa) makes it appear that the hypothesis being tested is that wages earned (hours) 2 years ago affect hours worked per week (wage) now. According to the dynamic model (equation (5)), however, these effects are essentially immediate. Use of lagged wage in the hours equation therefore is derived from a theoretical model in which effects of wage on hours are, in fact, immediate. Consequently, the regression coefficient associated with lagged hours is not a fundamental parameter of the process. That is, it does not indicate the immediate impact of wage on change in hours. It does, however, index the <u>total</u> effects of wage on hours accumulated over a 2-year time interval. What we have found here, therefore, is that the total effects of wage over a two year time period are essentially zero.*

The combined effects of nonmonetary rewards of work (or taste for work) are positive in the labor-force participation equation and negative in the unemployment equation, as hypothesized. Those effects also are positive in

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*This interpretation can be formalized in a manner consistent with the concept of total effect as used in the path analysis literature.

the hours and wage equations, as hypothesized, but they are only marginally significant when the school dummies are controlled and not significant when the school dummies are not controlled. On balance, the data reveal fairly good evidence of the effects of these work attitudes on employment outcomes during high school.

In contrast, the combined effects of the attitudes toward school are not statistically significant in any equation, though they approach significance in the unemployment equation and exhibit the hypothesized sign. Some of the behavioral measures of commitment to school are, however, associated with statistically significant coefficients. Cutting classes and skipping school tend to increase hours worked. Number of extra curricular activities in school decreases hours. These effects are in the hypothesized direction. Also, high educational and occupational expectations may be viewed as indicative of commitment to school. The negative effect of occupational expectation on hours, therefore, also agrees with the hypothesis that valuation on school decreases hours at work. In contrast, the pattern exhibited by the coefficients on the behavioral indicators of valuation on schooling and career expectations in the labor-force participation equation does not support the theory. In that equation, most of these coefficients are not significant or are only marginally so, and some of those that are significant have the wrong sign (e.g., number of extra curricular activities with school dummies controlled). It is concluded that the hypothesis that valuation on school decreases the supply of labor is not confirmed in these data.

The effects of school behaviors and career expectations in the two equations interpreted as primarily demand equations (wage and unemployment) are small. They do not support the hypothesis that employers prefer youth with strong valuation on school.

The results reported here contradict those reported by Hotchkiss, Bishop, and Gardner (1982) in 2 important respects. First, Hotchkiss and coauthors found strong effects of wage on hours and on labor-force participation. Secondly, they found stronger negative effects on hours of commitment to school than they found positive effects of indicators of nonmonetary rewards of work. Hotchkiss and his collaborators used the senior cohort of the HSB. The primary difference between their analyses and those reported here is that the former study relies on cross-sectional data; whereas, those in the present report make use of longitudinal data. Additionally, the present study makes use of a more extensive list of indicators of nonmonetary rewards of work and valuation on schooling than did the previous work. An interesting implication of the work based on longitudinal data is that cross-sectional estimates of wage effects on hours are biased due to simultaneity.

According to effect estimates in table 2.1, females and blacks work fewer hours per week than males and nonblacks, respectively. High education of father decreases hours worked; high family income increases hours. These findings imply that either the hours equation does not depend primarily on supply considerations or these personal and status characteristics affect unmeasured tastes for work. Although the equation does include the five indicators of nonmonetary work rewards--which indicate taste for work--this set of indicators probably is not extensive enough to rule out the possibility that the background variables affect hours because of their effects on tastes for work.

Gender exhibits a marked negative effect on wage, and this effect increases in absolute magnitude when between-school differences are controlled. On the other hand, apparent positive effects of being black or Hispanic on wage vanish entirely when between-school differences are removed. Family income and number of possessions in the home are associated with positive coefficients on wage. The effects of gender, income, and possessions on wage are consistent with the interpretation that employers prefer males and youth from relatively well-to-do families--and indicate their preferences by paying these youth relatively high wages. Absence of effects of other status variables, however, indicates relatively modest overall direct impact of status background on wage.

The facts that apparent positive effects of being black or Hispanic on wage disappear when between-school differences are removed have important implications for research on labor-market outcomes. Between-school differences are, in part, geographic differences. Blacks and Hispanics are concentrated in particular geographic locations. If they are concentrated in high wage areas, then their geographic distributions would tend to inflate their wages. In national samples without controls for local-area wages, therefore, blacks and Hispanics may appear to earn higher than do whites wages when personal characteristics are controlled. Such findings could be interpreted erroneously as "reverse discrimination." The impact of geographic distribution of minorities on their wages deserves careful scrutiny in any study including estimates of effects of minority status on wage.

Race is associated with a substantial increase in the likelihood of being unemployed-- 8.4 percent higher if school dummies are not controlled and 9.5 percent higher if they are. Since the coefficient increases when between-school differences are removed, the high rate of unemployment among blacks cannot be accounted for by their concentration in areas of high unemployment. Use of school dummies as controls even removes (at least for the most part) variations in unemployment rate within a metropolitan area, since most youth still attend neighborhood schools. None of the other personal and status characteristics exercise much influence on unemployment.

It is concluded that the primary background variables that affect demand are gender and race. Females earn lower wages than males. Blacks are more likely to be unemployed than whites.

Although the focus of this paper is not on testing human capital theory, it is noteworthy that the effects of past hours on current wage are quite strong in the case of hours worked last summer and last school year, but essentially zero for hours worked per week in the sophomore year in high school. In contrast, effects of test scores are relatively small and mostly not statistically significant.

The between-school differences are highly significant in the wage and labor-force participation equations but are not significant in the other 2 equations. In the wage equation, school differences likely reflect geographic differences in pay levels. Significant school effects in the labor-force participation equation suggests that schools or geographic location influence tastes for work. The finding suggests that it may yet be worthwhile to investigate school characteristics and processes that influence propensity to work.

Although use of the index of nonwage rewards of work and valuation on schooling imposes a useful parsimony on the models, it potentially masks information. Creating the indexes, in effect, by placing restrictions on the regression equations permits easy tests of the possibility that coefficients

TABLE 2.5

UNRESTRICTED COEFFICIENTS FOR COMPONENTS OF
NONWAGE REWARDS OF WORK AND VALUATION ON SCHOOL

	Hours Equation			Wage Equation			Labor-force Participation Equation			Unemployment Equation		
Independent Variable	Stan. Coeffi-cient	p(a) for Coeffi-cient	p(a) for Restric-tion	Stan. Coeffi-cient	p(a) for Coeffi-cient	p(a) for Restric-tion	Stan. Coeffi-cient	p(a) for Coeffi-cient	p(a) for Restric-tion	Stan. Coeffi-cient	p(a) for Coeffi-cient	p(a) for Restric-tion
Nonwage Research of Work												
Work values	.0282	.0001	--	.0312	.0001	--	.0154	.0165	--	-.0102	.1764	--
Work just for money*	-.0041	.5618	.4121	-.0041	.5808	.0851	.0005	.9426	.0443	.0211	.0067	.2943
Work more enjoyable than school	.0046	.5226	.7151	.0146	.0512	.7127	.0103	.1218	.6689	-.0105	.1810	.9101
Job encourages good work habits	-.0004	.9511	.1718	-.0084	.2585	.0019	.0151	.0226	.5905	-.0162	.0374	.7322
Enjoy working for pay	-.0012	.8608	.2830	.0130	.0707	.4649	.0140	.0296	.4546	-.0084	.2659	.4145
Valuation on School												
Satisfied with education	.0013	.8548	--	.0049	.5111	--	.0009	.8933	--	-.0261	.0008	--
Interested in school	.0009	.9060	.7434	.0058	.4792	.5975	-.0012	.8731	.7939	-.0007	.9379	.4064
Like working hard in school	-.0137	.0770	.0426	-.0271	.0007	.0009	.0084	.2436	.1911	.0141	.0958	.0251
Attitudes toward English & math	.0149	.0350	.0319	.0049	.5005	.1337	-.0056	.3944	.5104	.0099	.1990	.4703
Job more important than school*	.0011	.8837	.7921	-.0203	.0077	.0247	-.0091	.1807	.3238	-.0077	.3373	.0485
School rating index	.0001	.9920	.8913	-.0170	.0271	.0013	-.0061	.3769	.1048	-.0164	.0416	.0921
School problems rating index*	.0145	.0390	.0387	.0108	.1383	.3576	.0033	.6087	.3981	-.0052	.4919	.0567
Don't feel safe at school*	-.0144	.0392	.0323	-.0063	.3823	.2202	.0039	.5472	.4917	.0199	.0092	.0132

NOTES: 1. Coefficients are given for equation including control for school dummies.

2. p(a) for coefficient is the significance level of the regression coefficient.

3. p(a) for restriction is the significance for the null hypothesis that the coefficient does not differ from the other coefficients in the set (after norming by dividing each component by its standard deviation).

4. Items marked with an "*" are expected to have coefficients with reversed sign.

associated with some of the components of each index differ from each other. Table 2.5 displays (1) standardized coefficients on each component of the two indexes calculated by unrestricted OLS, (2) probability of a type I error ($p(\alpha)$) on each of these coefficients, and (3) tests of significance that eac coefficient except the first differs from the first (after weighting by the item standard deviation, as described previously).*

The added detail given in table 2.5 reveals essentially nothing new about the effects of attitudes indexing valuation on schooling. None of the effects of the components of valuation on school is noteworthy, and most are far from being statistically significant. On the other hand, there are some interesting findings regarding separate effects of the components of the nonmonetary work rewards. First, the apparent small effects of the index on hours and wage hide a highly significant effect of the work values index. This observation must be tempered, however, by the fact that only 1 of the tests of the restrictions on the work rewards items in these 2 equations is significant. The second point is that the individual items of the work rewards index have quite small and, at best, marginally significant coefficients in the labor-force participation and unemployment equations. Yet, with one very minor exception, the signs are all correct. Consequently, their combined effects are highly significant (see table 2.3 and table 2.4). It is concluded that the data in table 2.5 reinforce the conclusion that work attitudes associated with nonmonetary work rewards exercise important influence on work outcomes.

Conclusions

Because of the high incidence of working among high school students and increasing evidence that working during high school influences post high-school labor market success, it is important to understand the key factors that influence work experience during high school. This paper takes initial steps toward achieving that understanding. It investigates potential effects of a large number of variables on 4 work outcomes during high school--hours worked per week, wage, labor-force participation, and unemployment.

*The restrictions have entirely trivial effects on the coefficients not subject to restriction.

The investigation is carried out within a supply and demand theoretical framework. A standard utility model of labor supply predicts that hours of labor supplied are primarly a positive function of wage. The standard equilibrium model of supply is expanded in 2 primary respects. First, nonwage work rewards and valuation on school are added to the model, which initially includes only wage and hours. Second, the equilibrium model is generalized to account for changes over time. The demand theory is less formal. It is based on the fundamental idea that employer demand for young employees depends on wage, personal characteristics that are only roughly related to productivity (e.g., race, gender, SES), and on the strength of the local economy.

It is found that wage is not the primary determinant of labor supply, rather a set of attitudes used to reflect nonmonetary rewards of work influence hours and labor-force participation. These attitudes also affect wage and unemployment and are therefore interpreted as affecting employer demand. Although some behavioral indicators of valuation on school affect hours worked as predicted by the theory, the data indicate that valuation on school does not have a strong impact on work outcomes.

Two personal characteristics have strong effects on employment outcomes. Females earn over 12 cents an hour less than males with the same work experience, attitudes, race, and socioeconomic background. Blacks are over 9 percent more likely to be unemployed than whites, after controlling for work experience, attitudes, socioeconomic background, and school differences.

For educational policy, the primary implication of these findings is that schools should pay attention to development of work-related attitudes of their students. Good attitudes improve work outcomes. This finding supports views expressed in the recent National Commission Report on Secondary Vocational Education (1984). That report calls for a balance of educational goals among a broad spectrum of educational outcomes.

For national employment policy more generally, the findings here reinforce the need to enforce equity provisions of the law to assure females and blacks equal access.

CHAPTER 3

IMPACT OF CURRICULUM ON THE NON-COLLEGE BOUND YOUTHS' LABOR MARKET OUTCOMES

Suk Kang and John Bishop

Introduction

A number of blue ribbon-panels have called for the reform of America's secondary schools. In marshalling support for reforms, many of these panels have cited the need to improve the productivity of the work force through more effective schooling in order to regain a competitive edge in international markets.

Excellence in secondary education can improve the productivity of the nation's work force in at least four ways:

- By insuring that every young person obtains functional literacy--some minimum level of basic skills
- By improving the quality of the academic preparation of young people (especially for the two-thirds of high school graduates planning to attend college)
- By improving the quality of the vocational preparation of young people (especially of high school dropouts and the one third of high school graduates that do not attend college)
- By improving the employability skills (career selection, job search work habits, etc.) of young people

One of the recommendations that has often appeared in these reports is for increases in the number of courses in English, mathematics, science, and social science required for graduation from high school. Many state and local school systems have adopted these recommendations. The Nation at Risk report also recommended that there be increases in the length of the school day and the school year. Very few states have been willing, however, to budget the extra money necessary to pay for significant increases in the school day and/or the school year. With the amount of time a student spends in school remaining constant and an increase in the number of required courses in the new basics, a reduction in the time spent for on some other activity is necessary. Which activities should be reduced? Should the reduction be made in study halls, extra curricular activities scheduled during school hours, music and fine arts, physical education, life skills courses, or in vocational education? The answer to this question will not be the same for every student. High school graduates who do not want to go to college and plan to work immediately after graduating probably have very different feelings about course selection than the student who aspires to being an artist. How should students be advised? How should schools allocate their own resources among the different subject areas? The Nation at Risk report proposes that the productivity of the future work force be one of the criteria for making these judgements.

The three best indicators of an individual's economic productivity are the wage rates, earnings, and employment. Consequently, it will be useful to know how the choice of curriculum (which subjects a student chooses to study during high school) influences these outcomes. In this paper we will focus on the appropriate balance between academic and vocational education.

There have been many studies of the impact of high school vocational education on labor market success of its former students. These studies have tended to find that vocational education has a large economic payoff for women but a much smaller and often negative payoff for men.

Meyer (1981) found that for males, specializing in the trade and industry area had a statistically significant positive effect only in the year immediately following their graduation from high school. Gustman and Steinmeier (1981) and Mertens and Gardner (1981) reported hourly earnings disadvantages for ma business specialists, advantages for marketing specialists, and mixed results for trade and industry specialists. Rumberger and Daymont (1982) found that additional vocational credits were associated with higher hourly earnings if the credit was earned in a program that had provided skills that were being used on the respondent's job. Additional credits in vocational courses that were not related to the job reduced hourly earnings. However, the estimated effects of job-related courses were not significantly different from zero whether the vocational course work was expressed as total credits or as a proportion of total courses taken. The effect of secondary vocational education on the hourly or weekly earnings of women in commercial or office specialties is more consistently and significantly positive. Grasso and Shea (1981), Meyer, Gustman and Steinmeier (1981), Mertens and Gardner (1981), Campbell et al. (1982), and Rumberger and Daymont (1982) all reported significantly higher earnings for women who took vocational courses in the business and office area with various data sets.

Rumberger and Daymont (1982) found that taking additional academic course work--English, mathematics, science, social science, and foreign languages--significantly reduced unemployment of the young men and women who did not go to college and significantly increased the wage rate and hours worked of women. Except for a rather weak positive impact of academic course work on hours worked by young men, academic and vocational coursework had similar positive effects on the three indicators of labor market success. The residual category of courses--art, music, physical education, industrial arts, home economics, and miscellaneous--had the least favorable impacts on the three indicators of labor market success. Since employers seldom know how many academic courses a job candidate has taken, the coursework must be influencing labor market outcomes by contributing to the individual's verbal skills, math skills, and/or learning ability. These skills help individuals does better in interviews, fill out job applications more neatly and correctly, and learn job specific tasks more quickly.

This study focuses on the relative impact of high school academic and vocational education on the early labor market success of youth not attending college full time. We try to answer the following questions:

- What is the opportunity cost of academic education measured as lost earnings opportunities?
- Is it desirable to reduce the amount of vocational courses in high school and replace them by academic courses or vise versa?
- Are academic and vocational education complementary or is it optimal for the student to concentrate entirely on one or the other?
- Given the amount of resources available to high school education, what is the desirable combination of academic and vocational education that prepares noncollege-bound students for successful entry into the world of work?
- Which vocational field best prepares youth for employment? Are there differences in the effect of vocational education? Should males be advised to specialize in technical courses? Should females be advised to concentrate on commerical fields?

Answers to these questions are provided by analyzing two waves of questionnaire data obtained from the High School and Beyond (HSB) Survey on 3,000 1980 high school graduates who did not attend college full time. An outline of the paper is as follows. The High School and Beyond data is described in Section Two. The first part of Section Three presents a preliminary analysis of the data based on the cross tabulations of the three indicators of economic productivity--wage rate, employment and earnings--by the number of vocational courses taken, the number of academic courses taken, and the total number of both kinds of courses taken. These tabulations suggest that vocational and academic courses may be complementary. Based on this observation an econometric specification of the model is presented in the second part of the section. The model allows estimation of the degree of complementarity and the degree of decreasing returns from vocational and academic coursework. Section Four discusses the results and presents estimates of how time should be distributed between academic and vocational courses if one's goal is maximizing the individual's economic productivity immediately after high school. A summary is given in Section Five.

Data

Longitudinal data on the 1980 seniors completing the High School and Beyond (HSB) survey will be analyzed. The first wave of data collection occurred in March/April of 1980 while the young people were seniors in high school. The second wave of data collection was conducted in the spring of 1982 nearly 2 years after graduation from high school. The first wave contains various measures of education and grades in school, nonacademic activities such as participation in extracurricular activities, and work experience, as well as the students' family background, attitudes toward work, and career aspirations. At the time of the first wave survey, all respondents took standardized tests on three subjects, mathematics, reading, and vocabulary. These tests provide measures of the level of the basic skills which are comparable across respondents. The second wave contains a complete history of jobs held since 1980 and post high school educational experiences and earnings. Three measures of the respondents' labor markets success--earnings in 1981, number of months in which the respondent worked in the period between June 1980 and

February 1982, and average hourly wage rates during the 21-month period--were defined from the second wave interview.

Longitudinal data - available on a total of about 12,000 seniors. The subsample of this group was selected for this study by applying the following criteria: respondents had to have.

(1) graduated from high school in May or June 1980 and

(2) not attended school or college full time at anytime between June 80 to February 82.

The total number of observations that satisfy these selection criteria is 4,327. In the regression analysis the observations are further reduced by the omission of observations with certain key variables missing.*

These selection criteria and elimination of the observations with missing values reduced the total number of observations to 2,576 for earnings in 1981, to 2,485 for number of months worked, and to 2,058 for wage rates (see Appendix). We expect that the major activity of those in the sample is to -i-pate in labor market and that their experience in high school and their socioeconomic background will influence their success in labor market.

The labor market outcomes examined in the study are 1981 earnings; the number of months in which the individual worked between June 1980 and February 1982, and the average hourly wage rate during that period (see Appendix). These variables measure the labor market experiences that immediately follow high school graduation. The study focuses on how these measures of early labor market success are influenced by the selection of courses in high school and by performance in the courses selected. Data on what the youth studied in high school was obtained by asking the student to report how many years of courses he or she took in each of the following fields: mathematics, English

*Since the individual is counted as having worked in a month even if he or she worked for only part of the month or in a part time job, the number of months worked is not the same thing as total hours worked. An average hourly wage rate could not be calculated for about 385 people who did not have a job during the time period or who gave incomplete answers to wage questions in all their reported jobs. In addition wage rates greater than $15.00 an hour or less than $2.00 were assumed to be reporting errors (e.g. waiters not reporting their tips) and so were excluded from the sample.

or literature, French, German, Spanish, history or social science, science, business or sales, trade and industry, and technical and other vocational. In the analysis, the foreign languages are aggregated together and technical vocational programs are combined with trade and technical. The resulting list of variables describing the students curriculum is as follows:

Years of courses taken

Academic courses

1. Mathematics
2. English
3. Foreign language
4. History/Social Science
5. Science

Vocational courses

6. Business/Sales
7. Trade/Industrial and Technical
8. Other vocational courses

Grades and Test Scores

1. Received mostly A's or B's in business/office courses (self report)
2. Received mostly A's or B's in trade/technical, and other vocational courses (self report)
3. Mathematics standardized test scores (σ = 10)
4. Readings standardized test scores (σ = 10)
5. Vocabulary standardized test scores (σ = 10)

In addition to these explanatory variables we included the variables measuring respondents' socioeconomic and personal characteristics in the following categories:

- Geographic region
- Sex, race, ethnicity, age
- Family background
- Value scores and attitudes toward work
- Habits, school life
- Work experience while in high school
- Extracurricular activities
- Part-time student status
- Church attendance

Detailed list of variables in these categories are given in the Appendix 2.

Table 3.1 presents sample means and standard deviations of the variables for males and females separately and for the full sample.

TABLE 3.1

SAMPLE MEANS AND STANDARD DEVIATIONS

	Male Mean (S.D.)	Female Mean (S.D.)	Both Mean (S.D.)
Earnings in 1981 (dollars)	6,956 (5,429)	4,222 (3 981)	5,490 (4,900)
Number of Months Worked	13.47 (7.62)	11.66 (7.71)	12.48 (7.72)
Average Hourly Wage (dollars/hrs)	4.56 (1.65)	3.90 (1.00)	4.20 (1.37)
Years of Courses Taken			
Academic Courses			
Mathematics	1.89 (0.94)	1.71 (0.92)	1.79 (0.93)
English	2.87 (0.69)	2.90 (0.64)	2.89 (0.67)
Foreign Language	0.57 (0.96)	0.74 (1.01)	0.66 (0.94)
History, Social Science	2.24 (0.85)	2.22 (0.82)	2.23 (0.84)
Science	1.54 (0.89)	1.39 (0.87)	1.46 (0.89)
Total Academic	9.08 (2.70)	8.96 (2.61)	9.03 (2.66)
Vocational Courses			
Business, Sales	0.63 (0.84)	1.46 (1.14)	1.07 (1.09)
Trade and Technical	1.56 (1.75)	0.31 (0.81)	0.89 (1.47)
Other Vocational Courses	0.75 (1.09)	0.61 (0.96)	0.67 (1.02)
Total Vocational	2.94 (2.28)	2.38 (1.80)	2.63 (2.06)
Grades and Test Scores			
Received Mostly A or B			
Business and Sales	0.21 (0.41)	0.45 (0.50)	0.34 (0.47)
Trade and Other Vocational	0.37 (0.48)	0.07 (0.26)	0.20 (0.41)
GPA	77.6 (6.9)	80.0 (6.9)	78.9 (7.0)
Standardized Test Scores			
Mathematics	48.7 (9.7)	46.2 (8.8)	47.4 (9.3)
Reading	48.9 (10.4)	48.5 (9.6)	48.7 (10.0)
Vocabulary	48.7 (9.7)	48.3 (9.5)	48.5 (9.6)

Mean earnings in 1981 for the whole sample was $5,490. On average they were employed 12.5 months during 21-month period between June 80 and February 82, and their average hourly wage during that period was $4.20. In all three categories of labor market outcomes, males did better than females. Males earned an additional $2,734 per year, worked an additional 1.8 months, and were paid 66 cents more per hour than females.

Male and female high school graduates who do not go to college full time take similar numbers of courses in math, English, history, and science. The young women are more likely to study a foreign language and to take courses in business and office education. They average 1.46 years of business office education while young men average .63 years. Young men took an average of 1.56 years of trade, industrial, and technical courses while women took an average of .3 years. There is quite a lot of variation in the amount of trade and technical coursework taken by men.

Model

Previous studies of the impact of curriculum on labor market outcomes have specified the curriculum variables in two different ways. Grosso and Shea (1979), and Gustman and Steinmeier (1981) used a dummy variable for the self-reported curriculum track. However, when data on the courses taken are compared to self reports of curriculum tracks, it turns out that students reporting themselves in academic and general tracks are taking only slightly fewer vocational courses than students who report themselves to be in the vocational track. Since the costs of vocational education depend on the number and types of courses taken rather than the individuals state of mind about them, policy analysis requires information on how the courses taken (and credits received) in different fields influence labor market outcome.

Meyer (1981) and Rumberger and Daymont (1982) respond to this need by estimating models that characterize a student's curriculum as the number of credits (or proportion of all credits) received in a particular field. They make however, the simplifying assumption that credit hours (or proportions of total credit hours) have a constant linear impact on labor market outcomes. In other words, the assumption is made that the returns from extra courses in a particular field do not diminish and the payoff to one kind of education is independent of the amount of another type of education. In the work that follows we relax and then test these two assumptions. We hypothesize that a high school curriculum which completely specializes in vocational education and ignores training in basic skills will not be as effective as the one that provides both vocational skills and a certain level of basic skills. Vocational education must be built on a foundation of competency in mathematics, reading, vocabulary, and science. A high school curriculum that completely specializes in academic education may be appropriate for those planning to attend college full time. We hypothesize, however, that for individuals not going to college full time, such a choice will generally mean a sacrifice of earnings and employment in the years immediately following high school graduation.

Preliminary Analysis

Tables 3.2 through 3.4 may offer empirical evidence for our argument. Table 3.2 shows the mean values of the three labor market outcomes for subsamples classified by the self-reported number of full-year courses taken in academic and vocational subjects in the first 3 years of high school. As the table shows, for high school graduates who do not attend college, an increase in the number of academic and vocational courses has a moderate association with better labor market outcomes, especially when students take less than 16 full-year academic and vocational courses. Total academic and vocational coursework has no systematic relationship with the hourly wage. Raising the number of courses taken from 7 or less to 8 or 9 apparently increases months worked by about 13 percent but further increases in coursework have no further impact on time spent working. Taking 16 or more courses was associated with dramatically higher earnings for 1981 but variation in coursework over the range from 5 to 15 had only slight effects on earnings.

An examination of table 3.3 and table 3.4 reveals that the weak relationship between total academic and vocational coursework and labor market outcomes is due to two offsetting effects working against each other. For high school graduates who do not attend college full time--

- vocational coursework has a strong positive association with labor market outcomes, and

- academic coursework has a negative association with labor market outcomes.

TABLE 3.2

IMPACT OF THE NUMBER OF HIGH SCHOOL COURSES ON LABOR MARKET OUTCOMES OF HIGH SCHOOL GRADUATES WHO DO NOT ATTEND COLLEGE FULL TIME

Number of full year courses		Number of full year academic courses	Number of full year vocational courses	Outcomes: Wage	Outcomes: Percentage of months worked in 21 months	Outcomes: Earnings in 1981
0 - 7.5	(9%)	4.7	1.1	4.32	53.3	5065
8 - 9.5	(17%)	7.1	1.6	4.06	60.0	5131
10 - 11.5	(25%)	8.5	2.2	4.17	60.0	5644
12 - 13.5	(25%)	9.9	2.7	4.21	58.0	5387
14 - 15.5	(15%)	11.2	3.4	4.17	61.9	5356
16+	(9%)	12.2	5.7	4.45	59.0	6346

TABLE 3.3

IMPACT OF VOCATIONAL COURSEWORK ON LABOR MARKET OUTCOMES OF HIGH SCHOOL GRADUATES WHO DO NOT ATTEND COLLEGE FULL TIME

Number of full year vocational courses	Number of full year academic courses	Outcomes		
		Wage	Percentage of months worked in 21 months	Earnings in 1981
none - .5 (12%)	9.49	4.10	48.5	4031
0.5 - 1.0 (18%)	9.30	3.89	54.8	4526
1.5 - 2.0 (27%)	9.00	4.17	59.5	5470
2.5 - 3.0 (18%)	8.81	4.28	60.9	5606
3.5 - 4.0 (13%)	8.71	4.29	64.8	6334
4.5 - 5.0 (7%)	8.57	4.22	66.2	6421
5.5 - 6.0 (5%)	8.69	4.61	64.3	6471
6.5 - 7.0 (2%)	8.98	4.21	61.9	6893
7.5+ (3%)	9.19	4.80	60.0	6968

TABLE 3.4

IMPACT OF ACADEMIC COURSEWORK ON LABOR MARKET OUTCOMES OF HIGH SCHOOL GRADUATES WHO DO NOT ATTEND COLLEGE FULL TIME

		Outcomes		
Number of full year academic courses	Number of full year vocational courses	Wage	Percentage of months worked in 21 months	Earnings in 1981
- 3.5 (4%)	2.04	4.31	52.5	5300
4 - 5.5 (11%)	2.82	4.26	63.0	5777
6 - 7.5 (26%)	2.92	4.27	62.9	6083
8 - 9.5 (28%)	2.68	4.19	57.4	5290
10 - 12.5 (20%)	2.42	4.13	56.2	4998
12 - 13.5 (8%)	2.30	4.11	57.5	5226
14+ (3%)	1.82	4.06	60.3	4381

80

Table 3.3 classifies high school graduates who did not attend college full time by the amount of vocational coursework taken in the final 3 years of high school. Note that the number of academic courses taken (column 1) shows a very weak tendancy to decrease as the number of vocational courses taken increases. Apparently, increases in vocational coursework primarily come at the expense of study halls, free time, and courses not classified as either academic or vocational such as art, music, drivers education, and physical education. The table clearly demonstrates that high school graduates not attending college full time who took a vocational concentration in high school have higher wage rates, work a greater number of months, and earn a great deal more in the year or so after graduating than the 30 percent of such graduates who took fewer than 2 such courses. Students who took 4 full-year vocational courses received 8 percent higher wage rates, worked 23 percent more, and earned 47 percent (about $2000) more in 1981 than students who took less than 2 vocational courses.

Table 3.4 classifies the graduates by the number of academic courses taken. There is a mild tendancy for vocational coursework to decline as academic coursework rises. The graduates who obtain the most favorable labor market outcomes are those who take 6 to 7.5 full-year academic courses. The 15 percent who took fewer academic courses have about the same wage but work less and earn 5 to 10 percent less. Graduates who took 4 additional academic courses received a 3 percent lower wage, worked 11 percent less and earned 18 percent less.

These observations from tables 3.2 through 3.4 suggest the following:

- Provided students take a certain amount of academic courses, the number of vocational courses taken improve labor market outcomes.

- The effect of academic courses declines as students take more of them. Decline is accelerated if the increase in academic courses is accompanied by fewer vocational courses.

Furthermore, it is conceivable that the marginal effects of vocational courses decline as students take more vocational courses.

Econometric Specification of the Model

In what follows we propose an econometric model that focuses on the following:

- Differential effect of academic and vocational education by subject
- Interaction of academic and vocational education
- Change in the effects of academic and vocational education caused by the increase in total number of courses taken
- The combination of academic and vocational education that achieves the best labor market outcomes

In order to focus on the impact of curriculum, especially relative effects of academic and vocational courses, on labor market outcomes, we hypothesize the following relation between the labor market outcomes and curriculum:

$$(1) \quad y = \Sigma a_i A_i + \Sigma b_j V_j + c \cdot TA2 + d \cdot TV2 + f \cdot TAVX + \Sigma g_k Z_k + u$$

where y is a measure of labor market outcomes,

A_i is the amount of academic courses taken in the ith subject,

V_j is the amount of vocational courses taken in the jth subject,

TA2 is the sum of all academic courses taken squared $TA2 = (\Sigma A_i)^2$,

TV2 is the sum at all vocational courses taken squared $TV2 = (\Sigma V_j)^2$,

TAVX is the product of total academic coursework and total vocational course work $TAVX = (\Sigma_i A_i)(\Sigma_j V_j)$,

Z_k is the vector of other control variables such as grades, level of basic skills (mathematics, vocabulary, and readings) and socioeconomic, and background variables, and

u is the disturbance term.

The specification in equation (1) allows estimation of differential effects of vocational and academic course works by using separate measure of vocational and academic courses by subject. In addition, by introducing the squared terms (TA2, TV2) and the interaction term between academic and vocational courses, it is possible to estimate degrees of decreasing (or increasing) return fro and of compl- -tality (or substitutability) between the academic and vocational courses. . example, the marginal return from the additional academic course in the i th field is given by equation (2) as follows:

$$(2) \quad \frac{\partial y}{\partial A_i} = a_i + 2cTA + fTV$$

Equation (2) says that the marginal effect of the i th academic course depends on the coefficients for square term, c, and for interaction term f. When c is negative the marginal effect of academic courses decrease with the total amount of academic courses (decreasing returns), and when f is positive, the marginal effect of the academic course work increase if the vocational course work is increased. The marginal return from an additional vocational course in the j th field is given by equation (3).

$$(3) \quad \frac{\partial y}{\partial V_j} = b_j + 2dTV + fTA$$

If f is positive, academic and vocational courses will be termed complements. If f is negative, they can be called substitutes. Academic (vocational) education has increasing returns if c (d) is positive and has decreasing returns if c (d) is negative. Estimates of these coefficients make it possible to calculate what distribution of courses between academic and vocational subjects will maximize the measures of success in the labor market immediately after high school.

Results

The three labor market outcomes examined this study are earnings in 1981, number of months in which the individual worked between June 1980 through February 1982, and average hourly wage rate during the period. As a preliminary approach we regressed the three measures of labor market outcomes on the total amount of academic education and the total amount of vocational education along with a long list of control variables for males and females (see Appendix). The estimates of the coefficients for total academic and vocational courses are summarized in table 3.5. The point estimates of the

TABLE 3.5

IMPACT OF CURRICULUM ON EARLY MARKET SUCCESS*
(Academic Courses and Vocational Courses)

		Academic		Vocational	
Wage Rates	male	-.009	(.022)	.064**	(.027)
	female	-.034***	(.012)	.016	(.019)
Months Worked	male	-.113	(.093)	.161	(.107)
	female	-.301***	(.078)	.284**	(.118)
Earnings	male	-18	(63)	209***	(74)
	female	-212***	(41)	166***	(62)

*Standard errors in parentheses.

effects of vocational education are all positive. The estimated coefficients are significantly positive at the 1-percent level in the earnings equation for both males and females, and are significant at the 5-percent level in the months worked equation for females, and in the hourly wage equation for males. The point estimates of the coefficients for academic courses are all negative. The coefficients are all significantly negative at the 1-percent level for females but insignificant for males.

These results suggest that the balance between academic and vocational education does indeed have a strong influence on labor market outcomes. The estimates in these regressions, however, do not capture the differential effect of course work in a particular subject within vocational or academic education. Also, it is unlikely that the insignificance of academic education for males, and strong negative effect of academic courses for females prevail over the full range of possible variation in coursework. Further, the positive effect of vocational education may change as the level of academic education varys.

In order to see differential effects of the subjects in vocational and academic education we introduce the number of full-year courses in the five subject groups within academic courses (mathematics, English, foreign language, history and social science, and science) and in the three subjects groups within vocational courses (business and sales, trade and technical, and other vocational courses).

In order to approximate the nonlinear relation we include the quadratic terms for total academic and total vocational courses and an interaction term between the two. The three labor market outcomes are regressed on the curriculum variables, along with the scores on standardized tests (mathematics, reading, and vocabulary), grades, and a large group of control variables. The control variables included: dummies for nine census regions, residence in suburb, rural, or urban area, family background, scales measuring self esteem, locus of control, work orientation, family orientation, community orientation, church attendance, school attendance, reading habit, homework, deportment, participation in extra curricular activities and in noncredit educational programs, previous experience, marital status, and military status.

Gender Gap

For each dependent variable the equations were estimated for subsamples consisting of males only and females only, and for the full sample containing both sexes with a dummy variable for sex. The t-test of the gender dummy variable in pooled regression suggest that the coefficients for gender dummy are significant y different from zero at far below the 1-percent level in all three regressions. The coefficients on the gender dummy imply that other things being equal, males get paid 47.3 cents more per hour, work an additional 1.65 months in the 21-month period, and earn an additional $2,222 in 1981 than females. These values are close to the differences in average hourly wage rate, months worked, and earnings between males and females.

Another potential source of a gender gap may be differences in the effects of high school education, family background, basic skills, and other socio-economic variables on labor market outcomes. In order to see the effects of these variables on the gender gap, we tested the equality of the slope coefficients (other than gender dummies) for males and females. The results of the statistical tests are presented in table 3.6. The differences of slope coefficients are significant at the 5-percent level in all three outcomes and the difference in months worked is significant at the 1-percent level. Thus, there seems to be statistically significant differences in the structure of the relationship between personal characteristics and labor market outcomes. Consequently, the estimation results are presented for separate samples of males and females.

Marginal Effects of the Types of Courses Taken

The result of the estimation of the models are given in table 3.7 through table 3.9. Our main interest is in the marginal effects of academic and vocational education by subject and how these marginal effects change with the amount of academic and vocational coursework. The results are analyzed first by looking at the estimates of the marginal returns from education that are given by the linear combinations of coefficients presented in tables 3.7 through 3.9.

In tables 3.7 through 3.9 the coefficients on the square of academic coursework and the square of vocational coursework provide an estimate of the

TABLE 3.6

TEST OF GENDER GAP

Joint Test of Slope Coefficients
(excluding sex dummy)

	Earnings in 1981	Total Months Worked	Average Hourly Wage
F-Value	1.38	1.46	1.28
Degrees of freedom	(77 , 2422)	(77 , 2331)	(77 , 1904)

95% significance point = 1.25
99% significance point = 1.42

Test of Significance, Sex Dummy

	Earnings in 1981	Total Months Worked	Average Hourly Wage
Point Estimate	-2222.	-1.64	-.473
t-value	(-8.93)	(-4.04)	(-5.76)
Degrees of freedom	2498	2407	1980

TABLE 3.7

ESTIMATION RESULT

AVERAGE HOURLY WAGE

	Male	Female
Years of Courses Taken		
Mathematics	-0.124 (0.117)	0.002 (0.076)
English	-0.010 (0.115)	0.019 (0.069)
Foreign Language	-0.226 (0.142)	-0.023 (0.079)
History, Social Science	-0.217 (0.120)	-0.170**(0.073)
Science	-0.216 (0.129)	0.002 (0.077)
Business, Sales	-0.095 (0.128)	0.000 (0.081)
Trade & Technical	-0.096 (0.107)	-0.103 (0.098)
Other Vocational Education	-0.126 (0.113)	-0.066 (0.085)
Vocational Courses Squared	0.004 (0.007)	0.002 (0.006)
Academic Courses Squared	0.006 (0.005)	-0.001 (0.003)
Vocational x Academic	0.014* (0.008)	0.006 (0.007)
Grades and Test Scores		
Received Mostly A's and B's in;		
Business and Sales	-0.139 (0.153)	0.031 (0.073)
Trade and Other Vocational Education Courses	0.250* (0.135)	0.027 (0.125)
GPA	0.004 (0.010)	0.012**(0.006)
Standardized Test Scores		
Mathematics	-0.007 (0.008)	-0.007 (0.005)
Reading	0.001 (0.007)	0.004 (0.004)
Vocabulary	-0.003 (0.007)	0.001 (0.004)
Number of Observations	942	1116
R^2	0.149	0.099
F-value (degrees of freedom)	1.99 (77,865)	1.50 (77,1039)

*significant at 10 percent level (both sides)
**significant at 5 percent level (both sides)
***significant at 1 percent level (both sides)

Note: numbers in the parentheses are standard errors

TABLE 3.8

ESTIMATION RESULT

TOTAL MONTHS WORKED

	Number of Months Worked			
	Male		Female	
Years of Courses Taken				
Mathematics	0.269	(0.478)	0.354	(0.441)
English	-0.405	(0.460)	0.073	(0.393)
Foreign Language	0.305	(0.574)	0.932**	(0.466)
History, Social Science	-0.043	(0.486)	0.275	(0.435)
Science	0.425	(0.517)	0.344	(0.451)
Business, Sales	1.093**	(0.517)	1.476***	(0.490)
Trade & Technical	0.653	(0.432)	1.624***	(0.613)
Other Vocational Education	0.753	(0.466)	1.539***	(0.518)
Vocational Courses Squared	-0.029	(0.029)	-0.100**	(0.041)
Academic Courses Squared	-0.009	(0.023)	-0.031*	(0.018)
Vocational x Academic	-0.033	(0.036)	-0.064	(0.040)
Grades and Test Scores				
Received Mostly A's and B's in;				
Business and Sales	0.670	(0.635)	0.173	(0.464)
Trade and Other Vocational Education Courses	0.148	(0.554)	-0.752	(0.811)
GPA	0.001	(0.040)	0.028	(0.036)
Standardized Test Scores				
Mathematics	-0.013	(0.032)	0.062**	(0.030)
Reading	0.063**	(0.029)	0.070**	(0.026)
Vocabulary	0.077**	(0.030)	0.034	(0.027)
Number of Observations	1130		1355	
R^2	0.161		0.216	
F-value (degrees of freedom)	2.67 (77,1053)		5.90 (77,1278)	

*significant at 10 percent level (both sides)
**significant at 5 percent level (both sides)
***significant at 1 percent level (both sides)

Note: numbers in the parentheses are standard errors

TABLE 3.9

ESTIMATION RESULT

EARNINGS IN 81

	Male		Female	
Years of Courses Taken				
Mathematics	310	(332)	-271	(231)
English	272	(320)	-176	(207)
Foreign Language	204	(397)	-297	(242)
History, Social Science	117	(335)	-422*	(228)
Science	-43	(357)	-206	(236)
Business, Sales	-92	(355)	658**	(257)
Trade & Technical	3	(299)	609*	(317)
Other Vocational Education	324	(320)	596**	(271)
Vocational Courses Squared	-30	(20)	-35*	(22)
Academic Courses Squared	-16	(16)	7	(10)
Vocational x Academic	41*	(25)	-24	(21)
Grades and Test Scores				
Received Mostly A's and B's in;				
Business and S les	241	(435)	55	(245)
Trade and Other Vocational Education Courses	647*	(275)	-338	(429)
GPA	34	(27)	37**	(18)
Standardized Test Scores				
Mathematics	-25	(22)	19	(16)
Reading	-16	(20)	16	(14)
Vocabulary	59***	(21)	1	(14)
Number of Observations	1195		1381	
R^2	0.173		0.214	
F-value (degrees of freedom)	3.09 (77,1118)		4.68 (77,1304)	

*significant at 10 percent level (both sides)
**significant at 5 percent level (both sides)
***significant at 1 percent level (both sides)

Note: numbers in the parentheses are standard errors

degree of diminishing returns. The coefficients on the square terms are negative as hypothesized in the months worked regressions and three of four coefficients are negative in the earnings equations. Three of these coefficients are significantly negative. In the female months worked equation the coefficient estimates are significantly negative for both of the squared terms, and in the female earnings equation the marginal return from vocational courses is significantly decreasing. Only one of the four coefficients on square terms in the wage rate regression are negative but all of them are very close to zero.

It was hypothesized that academic and vocational courses are complementary. Two of the six estimated coefficients are significantly positive as hypothesized. The hypothesis of complementarity is accepted for the earnings and the wage rates of males.

Table 3.10 presents estimates of the impact of one more course in each specific field of study. The marginal return from the i th academic course is given by $a_i + 2c\,TA + fTV$ and the marginal return from the j th vocational course is $b_j + 2d \cdot TV + f \cdot TA$. As we can see from these equations the marginal return changes with the levels of total academic courses (TA) and total vocational courses (TV) so the estimates of the marginal returns reported for each subject area have been evaluated at the sample means for the total number of academic and vocational courses. The sample means of TA are about 9 for both females and males and the means of TV are 2.9 for males and 2.4 for females. The entries in the table show that the marginal returns to vocational education are positive for both females and males with the exception of the trade and technical and other vocational courses' impact on the wage rates of females. The magnitudes of the marginal effect from each subject vary by the measures of labor market success.

For men, the point estimates in the earnings equation apparently imply that the highest returns come from taking other vocational courses and the next highest returns come from taking trade and technical courses. Trade and technical courses seem to be most effective in raising the wage rate but have very little impact on employment. Business and sales courses seem to have the opposite effect; they help male students get and keep jobs but their effect on the wage rate is minimal.

TABLE 3.10

POINT ESTIMATES OF THE
MARGINAL RETURN FROM COURSE WORK BY SUBJECT

	Wage Rate		Total Months Worked		Earnings in 1981	
	Male	Female	Male	Female	Male	Female
<u>Academic Courses</u>						
Mathematics	.026	-.109	.009	-.355	140	-204
English	.140	-.092	-.665	-.636	102	-109
Foreign Language	-.076	-.134	.045	.223	34	-230
Social Science	-.067	-.281	-.303	-.434	-53	-355
Science	-.066	-.109	.165	-.365	-213	-139
<u>Change in Marginal return by</u>						
Academic Courses	.012	-.014	-.018	-.062*	-32	14
Vocational Courses	.014*	.006	-.033	-.064	41*	-24
<u>Marginal Return from Vocational Courses</u>						
Business/Sales	.012	.063	.623	.421	104	275
Trade/Technical	.401	-.040	.183	.569	199	226
Other Vocational	.155	-.003	.283	.484	523	213
<u>Change in Marginal return from</u>						
Academic Courses	.014*	.006	-.033	-.064	41*	-24
Vocational Courses	.008	.004	-.058	-.200*	-60	-70*

For females, the marginal effects of vocational subjects do not vary much with particular subjects. Point estimates for the impact of 1 year of course work range from 0.42 to 0.57 months for employment and from $213 to $275 for earnings.

The changes in the marginal returns due to additional vocational and academic courses are given in the second and fourth panel of table 3.10. The asterisk ("*") indicates that the changes are significantly different from zero at the 10-percent level. The impact of vocational education on earnings and employment decreases as students take more courses in vocational education and the effects are statistically significant for females (see the second row in the fourth panel). Each additional year of vocational education lowers the return to the next year of vocational education by $70 in the earnings model and by 1/5 month in the employment model. For males, the impact of vocational education on wage rates and earnings significantly increases as the number of academic courses increases (see the second panel in the second panel).

The marginal return from academic courses are mostly negative for females, however, mathematics and English seem to have positive effect on male students. For males, the marginal effects of mathematics are positive for all three indicators of labor market success, and those of English are positive in wage and earnings. Significant decline in the marginal effect of academic courses is found in months worked for females. For females, an additional unit of academic course work reduces the marginal effect of academic education by 0.06 month.

The Effects of Grades and Basic Skills

The short run effects of academic and vocational education further vary by the grades in vocational and academic courses. As the measures of performance in vocational courses we included two dummy variables indicating whether student got mostly A's or B's in business and sales courses and whether they got mostly A's or B's in trade and technical and other vocational courses. The performance in academic courses was measured by the overall grade point average (GPA).* Since GPA includes the grades in vocational courses as well

*GPA is measured as, mostly A (90-100) about half A and half B (85-89), mostly B (80-84), about half B and half C (75-79), mostly C (70-74), about half C and half D (65-69), mostly D (60-64), mostly below D (below 60).

as those in academic courses, GPA is not a pure measure of performance in academic courses. However, regressing the outcomes on GPA along with grade variables in vocational courses the regression coefficient for GPA gives a reasonable estimate of the effect of performance in academic courses. The estimated coefficients are included in the tables 3.7 through 3.9. Comparison of the effects of the grades for males and females reveal the following effects of the grades on labor market outcomes.

- For women, a good GPA substantially improves wage rate and earnings. A one standard deviation (7 points) increase in GPA raises the hourly wage by 9 cents (table 3.7) and yearly earnings by $260 (table 3.9).* The effects of good grades in vocational education, are not significantly different from zero in all three outcomes.

- For males, GPA has no significant impact on all three outcomes. Higher grades in trade and technical and other vocational education (excluding business and sales) result in higher earnings and higher hourly wage, however. Higher grades (mostly A or B) in these vocational courses increase yearly earnings by $650 (table 3.9) and the hourly wage by 25 cents (table 3.9) compared to the case when they get lower grades (below C).

In addition to course grades we included the scores on standardized tests in mathematics, reading, and vocabulary as the measures of basic skills level in the regressions. The regression coefficients for these test scores reflect the effects of basic skills not captured by grades and the number of vocational and academic courses. Despite the colinearity between these test scores and between GPA and test scores, many of these tests have statistically significant positive effects on employment and earnings. For both males and females the test score in reading has a statistically significant positive effect on employment. The magnitude of the effects are similar for both males and females. A one standard deviation (10 points) increase in the reading test score increases months worked by 5 or 6 percent for both sexes.

Vocabulary has a significant impact on the employment and earnings of males. A one standard deviation increase in the vocabulary test score increases months of employment by 6 percent and earnings by $590 per year.

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*The effects of improvement in GPA are obtained by the multiplication of the point estimates of the coefficients for GPA by the one sample standard deviation (7 points) of GPA.

Mathematic skills apparently have no significant effect on the labor market outcomes of males. The point estimate of the effects of mathematic skill are negative in all three equations and they are not significantly different from zero. However, mathematics does have a positive effect on the employment of women and its effect is about the same as reading skill.

Prediction of the Earnings by the Levels of Academic and Vocational Courses

The above results imply that academic and vocational course work have curvilinear impacts on labor market success. Consequently, it is desirable for high school students who are not planning to attend college to combine vocational and academic coursework. In this section we use the estimated coefficients from the earnings equation to calculate an ideal combination of academic and vocational education that maximizes earnings in the calendar year following graduation. Among the three measures of labor market outcomes, earnings is the single most appropriate measure of the labor market success and the estimated coefficients suggest that given a total number of courses there exists an optimal combination of academic and vocational education.* The comparisons are made between the predicted values of earnings when students take the "best" combination courses in academic and vocational education and when the students take a "typical" combinations of vocational and academic courses, which are given by sample mean values for various levels of total courses. Limitations on the concept of ideal combination should be emphasized. First, the ideal combination is defined in terms of the predicted earnings in the short-run (the period of 6 to 18 months after leaving high school) for students whose highest education is high school. The combination that maximizes earnings in the short-run may not be the best one in the long run. Second, the underlining assumption of the computation of the ideal combination is that the relative weights of the subjects in the academic and vocational fields are fixed at their current level. Shifts of relative weights within

*In computing an "ideal" combination, the unrestricted estimates in the female earning equation do not guarantee the existence of the inner solution. The computation of an "ideal" combination for female earnings is based on the restricted estimates which imposed zero constraint on the coefficient for the interaction term.

academic and vocational fields may change the ideal combination. Finally, the errors in the predicted earnings and the ideal combination increase as the constraint on total number of courses diverges from sample mean values. These errors are unavoidable because of the errors in the coefficient estimate and because of approximation error in the functional form.

Table 3.11 shows the results of the comparisons for both males and females. The first column gives the total number of full-year courses. The second and third columns show the number of vocational courses which maximizes earnings and the level of earnings that is predicted when that combination is chosen. The fourth column gives the typical number of vocational courses taken by students who take the total number of courses given in the first column. The fifth column shows the differences between the predicted income at the income max in mix of vocational and academic course combination and the income at the "typical" combination. Column 6 presents the effect of reducing vocational courses to half of the typical amount.

From table 3.11 we can see the following:

- When students choose the ideal combination of academic and vocational courses, an increase in the number of courses from 8 to 16 raises the yearly earnings b about \$950 (\$6,938 to \$7,882) for males and about \$600 (\$4,422 to \$5,046) for females.
- The gain in earnings by choosing the ideal combination, compared to the typical program, is \$143 to \$207 for males and \$323 to \$423 depending on the total number of courses.
- When vocational education is cut to half of the "typical" amount, the predicted earnings decline drastically, especially when the number of total courses is large. The declines are about \$200 compared to the "typical" program when they take total of 8 courses for both females and male. For large values of the total courses, the declines are larger. The predicted declines are over \$1,000 for males and about \$650 for females when they take total of 16 courses.

Policy implications from these observations may be summarized as follows:

1. Increases in the number of academic and vocational courses taken in the last 3 years of high school improve labor market outcomes. However, the extent of improvement measured in terms of additional earnings is not large.
2. Current level of vocational education is slightly less than the level that maximizes earnings for male students.

TABLE 3.11

INCOME MAXIMIZING COMBINATION OF
ACADEMIC AND VOCATIONAL EDUCATION

Number of courses in years	Income maximizing vocational courses (in years)	Predicted income at more maximizing mix of courses	Typical vocational courses (in years)	Predicted income max mix is reduced to typical	Predicted decline if income max mix is reduced to half of typical mix
Male					
8	2.68	$6,938	1.40	-$143	-$342
10	3.52	$7,182	2.05	-$189	-$543
12	4.36	$7,421	2.82	-$207	-$758
14	5.21	$7,654	3.71	-$193	-$974
16	6.04	$7,882	4.72	-$152	-$1179
Female					
8	4.62	$4,422	1.44	-$417	-$626
10	5.21	$4,680	2.00	-$423	-$727
12	5.79	$4,870	2.64	-$409	-$822
14	6.38	$4,992	3.36	-$375	-$907
16	6.96	$5,046	4.16	-$323	-$980

3. Gain in increasing vocational education from the current level is higher for females than for males.

4. Substitution of academic courses for vocational courses from the current level drastically worsen the labor market outcomes measured in terms of earnings.

Summary and Conclusions

In this study we analyzed the relative impact of high school academic and vocational education, performance in course work, and the skill levels in basics (English and mathematics) on non-college bound youths' labor market outcomes. For one-third of high school graduates, who do not go to college full time and plan to work immediately after high school, the choice of course work in high school is one of the most important decisions which influence their labor market outcomes after graduation.

The High School and Beyond (HSB) Survey conducted in 1980 and 1982 provided a rich data source for the study.

The HSB data contains detailed information on high school students' choice of and performance in course work, the test scores in basic skills, work experience in high school, and the labor market outcomes after graduation, as well as their socioeconomic backgrounds.

From the cross tabulation analysis of the course work in academic and vocational fields; and labor market outcomes we found the presence of the following patterns:

- Taking additional vocational courses is only slightly associated with taking fewer courses in the core academic courses. This implies that the trade offs are made with such options as study halls, music, fine arts, physical education, and in-school extra curricular activities.
- Taking additional vocational courses is strongly associated with success in the labor market imemediately after high school. Non-college-bound students who took at least four vocational courses in their last three years of high school were more employable than the 30 percent who took one or fewer vocational courses. They received an 8 percent higher wage rate, earned 47 percent more income, and were 23 percent more likely to be employed.
- Taking additional academic courses is not associated with higher earnings immediately after high school. Non-college-bound students who took 12 to 14 rather than 6 to 8 academic courses in

their final three years of high school received a 3.5 percent lower wage rate, earned 14 percent less income, and worked 8.5 percent less.

- Taking an increased amount of both academic and vocational course work is associated with greater success in the labor market. Noncollege-bound students who took 16 or more academic and vocational courses during their final three years in high school met with greater labor market success than students who took fewer than 10 such courses. The group taking more courses received a 7 percent higher wage rate, earned 24 percent more income, and worked 2 percent more than those taking fewer than 10 courses.

These observed patterns seemed to suggest that the vocational education has strong positive impact on success in the labor market, and the effect of academic education is smaller than the effect of vocational educations.

The result of the linear regression model did not change the nature of the underlying relationships. In the regression analysis, the three measures of labor market outcomes--wage rate, months employed, and earnings in 1981--are explained by the number of courses taken in various subjects in the vocational and academic fields, the standardized test score in basics and grades in course work, after controlling for the students' socioeconomic backgrounds. The estimates from the linear model (table 3.5) predict taking four vocational courses increases a male's wage rate by a significant 5.6 percent, months employed by 4.8 percent, and earnings by 12 percent. For females the increases are 1.6 percent for wage rates, a statistically significant 9.7 percent for months worked, and significant 15.7 percent for earnings. For women, academic course work has significant negative effects on all three outcomes.

However, we argued that the complete specialization in vocational education which ingnores the training in basic skills will not be as effective as the one that provides both vocational skills and competency in basic skills. This view is supported by the result of the quardratic form regression model.

The quadratic specification of the model allowed estimation and testing of the degrees of decreasing returns from specialization in one field, and the degree of complementarity between academic and vocational education.

The estimation results supported our hypothesis: the effect of additional vocational (academic) course work decreases if the level of academic (vocational) course work is kept constant (<u>decreasing returns</u> from specialization), and the marginal effect of vocational education is higher if the amount of academic course work is increased and vice versa (complementarity between academic and vocational course work). The decreasing return is signaled by the neg - tive coefficients for the squared terms and positive coefficients for the interaction terms indicate the complementarity of academic and vocational course work.

Among the 12 estimated coefficients for the squared terms for the number of academic courses and the number of vocational courses, 8 are negative, 3 of them are significantly negative, and none of the coefficients with positive sign is significantly different from zero. Among the 6 estimated coefficients for the interaction terms 3 are positive, 2 of them are significantly positive, and none is significantly negative. These estimates suggest that there are decreasing returns from specialization and a complementarity exists between academic and vocational education. The estimates from the quardratic model are used in deriving desirable combinations of vocational and academic education that maximize earnings, given various total amounts of course work.

The estimated coefficients suggest that the mix of courses that maximizes earnings in the calendar year after high school is:

--about 36 percent vocational for males
--about 48 percent vocational for females.

The current typical level of vocational education is slightly less than the "optimal" and the gain from increase in vocational education from the current level is not large. However, the reduction of vocational education to the half of the current level drastically worsens the earnings for both males and females. The predicted decline in yearly income is nearly $500 for males and $400 for females.

In addition to the choice of curriculum, performance in course work and the level of basic skills also influence the labor market outcomes. Good performance in course work and basic skill tests generally improve students' labor market outcomes. However, there are some differences between males and females.

--For females a good GPA improves wage rate and earnings. A one standard deviation increase in GPA raises the hourly wage by 9 cents, and yearly earnings by 6 percent, but getting good grades in vocational courses does not affect labor market outcomes. Among basic test scores, mathematics and reading have significant effects on months of employment. Ten-point increase in these tests increases employment by 5 to 6 percent.

--For males GPA does not affect immediate labor market outcomes, but a good grade in trade and technical coures substantially improve the outcomes. Those who received mostly A's and B's in these courses enjoy higher hourly wage (25 cents more), and 7 percent higher earnings ($650 in 1981). Among the tests of basic skills scores vocabulary and readings have significant effects on employment and earnings. Ten-point increase in these test scores increases employment by 6 percent and earnings by nearly $590 in 1981.

APPENDIX 1

SELECTING SAMPLES

The samples used in the estimation are selected by the following criteria:

1. Responded in both the first and second wave survey.

2. Did not attend college as a full-time student after leaving high school

3. Left high school in May or June 1980.

4,327 out of the original 11,995 respondents satisfy these three conditions. The sample size is further reduced by eliminating the samples with missing values. The final numbers of samples used in each equation are as follows:

dependent variables	male	female	male and female
wage	942	1116	2058
earnings in 81	1195	1381	2576
total months worked	1130	1355	2485

APPENDIX 2

The control variables used in regression analysis are as follows:

Geographic region

- Dummy variable for suburb
- Dummy variable for rural (default is urban)
- 8 dummy variables for 9 census regions, New England, South Atlantic, East South Central, West South Central, East North Central, West North Central, Mountain, and Pacific (default is Mid-Atlantic)

Sex, rac , ethnicity, age

- Dummy for sex (male = 0, female = 1)
- Race (white = 0, non-white = 1)
- Hispanic (Hispanic = 1, non-Hispanic = 0)
- Age (age as of May 1980)
- presence of physical handicap
- Graduated from high school

Family background

- Family income (in thousands)
- Mother's education (in years)
- Father's education (in years)
- Dummy for family income data missing
- Number fo siblings
- Dummy for "parents know what their kids are doing"

Value scores and attitude toward work

- Psychological scales for self concept, locus of control, work orientation, family orientation, community orientation
- Dummy variables for enjoy work for pay, like to work hard in school
- Church attendance (scale 0 to 1)

Habits and school life

- Dummy for "read books for pleasure"
- Dummy for "read news paper"
- Scale for having difficulty in adjusting to school life
- Dummy for presence of school disciplinary problem
- Dummy for occutionary cut classes"
- Hours spent working on homework per week

Extracurricular activities

- 12 scales for participation in extracurricular activity in atheletic club, cheer leaders and pep club, debate and drama club, school band, hobby club, honorary club, school newspaper, subject matter club, student government, vocational club, youth club.

Part-time student status

- Dummy for part time student after leaving high school

Work experience

- Number of hours worked for pay per week during senior year
- Number of hours worked for pay per week during summer of 1979
- Number of hours worked for pay per week during junior year

Marital status

- Dummy for married

Military status

- Dummy for active military service

APPENDIX 3

CREATION OF WAGE RATE, MONTH WORKED, AND EARNINGS DATA

The next two pages show the questions from which wage rate data are created. The respondents reported occupation and industry of the job, starting month and year, starting wage rate, average weekly work hours, ending or current wage rate, and ending or current month and year for up to five jobs they experienced after graduation (June 1980 to February 1982). Average hourly wage is defined as the total earnings during the 21 month period divided by the total work hours. The total earnings is obtained by assuming that wage rate growth is linear in time and that weekly work hours is constant in one job spell. Earnings in 1981 is obtained from the self reported yearly earning in 1981 (question is not shown). Months worked is obtained from the response to the question: "Which months did you work or serve in the military since you left high school?"

4. Continued.

	COLUMN A 1ST JOB AFTER HIGH SCHOOL	COLUMN B 2ND JOB AFTER HIGH SCHOOL
What kind of job or occupation did or do you have? (For example, salesperson, waitress, secretary, etc.) (WRITE IN)→	Office Use Only	Office Use Only
What kind of business or industry was this job in? (For example, retail shoe store, restaurant, etc.) (WRITE IN)→	Office Use Only	Office Use Only
What were your main activities or duties on this job? (For example, selling shoes, waiting on tables, etc.) (WRITE IN)→		
In this job were you . . . (MARK APPROPRIATE CATEGORY)	An employee of a PRIVATE COMPANY ○ A GOVERNMENT employee (federal, state, local) ○ Self-employed in your OWN business ○ Working WITHOUT PAY in family business or farm ○	An employee of a PRIVATE COMPANY ○ A GOVERNMENT employee (federal, state, local) ○ Self-employed in your OWN business ○ Working WITHOUT PAY in family business or farm ○
When did you start working at this job? (MARK OVALS FOR MONTH and YEAR)	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1976 or before ○1977 ○1978 ○1979 ○1980 ○1981 ○1982	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1980 ○1981 ○1982
When did you leave this job? (MARK OVALS FOR MONTH and YEAR.) (IF YOU STILL HAVE THIS JOB, MARK THIS OVAL.)→	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1980 ○1981 ○1982 Still have this job ○	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1980 ○1981 ○1982 Still have this job ○
What was your starting salary on this job? (WRITE IN)	(MARK ONE) $______ ○hourly ○weekly Office Use Only	(MARK ONE) $______ ○hourly ○weekly Office Use Only
PLEASE READ INSTRUCTIONS→	GO TO COLUMN A, PAGE 10.	GO TO COLUMN B, PAGE 10.

	1ST JOB AFTER HIGH SCHOOL	2ND JOB AFTER HIGH SCHOOL
What is your salary on this job or what was it at the time that you left? (WRITE IN)	(MARK ONE) $______ hourly / weekly Office Use Only	(MARK ONE) $______ hourly / weekly Office Use Only
About how many hours a week did or do you usually work in this job? (WRITE IN)	______ hours per week Office Use Only	______ hours per week Office Use Only
) How did you find this job? (MARK MOST IMPORTANT CATEGORY)	School employment or placement service Public employment service Private employment agency Newspaper advertisement Checked with employer directly Through a relative Through a friend Civil Service application Other (WRITE IN) ______	School employment or placement service Public employment service Private employment agency Newspaper advertisement Checked with employer directly Through a relative Through a friend Civil Service application Other (WRITE IN) ______
1) Why did you leave this job? (MARK APPROPRIATE CATEGORY)	Lost job (fired, laid off, job ended) Left job to return to school Quit because job, hours, or pay, etc. unsatisfactory Still have this job Other (WRITE IN) ______	Lost job (fired, laid off, job ended) Left job to return to school Quit because job, hours, or pay, etc. unsatisfactory Still have this job Other (WRITE IN) ______
2) Were you without a job AND *looking for work* right after you left this job? (MARK APPROPRIATE CATEGORY) (IF YOU STILL HAVE THIS JOB, MARK THIS OVAL.)—	Yes (FOR HOW MANY WEEKS?—WRITE IN) ______ weeks No Still have this job Office Use Only	Yes (FOR HOW MANY WEEKS?—WRITE IN) ______ weeks No Still have this job Office Use Only
PLEASE READ INSTRUCTIONS—	TURN BACK TO PAGE 8 AND CONTINUE WITH YOUR SECOND JOB. IF YOU HAD NO OTHER JOB, GO TO Q. 25 ON PAGE 12.	TURN BACK TO PAGE 9 AND CONTINUE WITH YOUR THIRD JOB. IF YOU HAD NO OTHER JOB, GO TO Q. 25 ON PAGE 12.

CHAPTER 4

TIME PROFILE OF YOUTHS' LABOR MARKET OUTCOMES: AN ANALYSIS OF HIGH SCHOOL AND BEYOND DATA

Suk Kang

Introduction

High school education and experience influence youthful workers' labor market outcomes. These outcomes are determined by youths' ability to find jobs, to perform on the jobs, and to keep them. In this study, the impact of three aspects of high school education on the labor market outcomes are analyzed. The first is curriculum: combination of basic academic (English and mathematics) courses, other academic courses, and vocational education. The second is the level of achievement and student's ability. The third is work experience in high school.

To acquire a desirable attitude toward and aptitude for work and to prepare students for the world of work, work experience in high school should play an important role in determining youths' labor market outcomes. In this study, we analyzed the relationship between three measures of labor market performance--work hours, wage rate, and earnings--and three kinds of preparation in high school--curriculum, achievement level, and high school work experience.

Our analysis is based on high school graduates who did not attend post secondary school as full-time students. We can assume that the major activity of these students is participation in the labor market. High school experiences are some of the most important factors in determining the labor market outcomes for those youths.

The data are obtained from the two waves of the 1980 High School and Beyond (HSB) Senior Cohort Survey. The initial wave covered more than 12,000 high school seniors from about 1,000 schools in the spring of 1980 and the follow-up survey was conducted 2 years later. The first survey collected a wide range of facts: socio-economic or family background, course work, grades in various courses, work experience, and attitude and aspiration information.

Also at the time of the first survey, students took standardized tests in reading, vocabulary, and mathematics. Scores on these test provide good measures of student's basic skill level. The Second survey asked the detailed questions about students' labor market experience after graduation. From these questions we constructed a history of students' labor market outcomes. This data set allows us to analyze the time profile of the effect of high school experience.

There have been many studies on the impact of high school vocational education on youth labor market outcomes. The evidence from previous studies varies, depending on the data sets and individuals' gender. In the study of the National Longitudinal Survey (NLS) 1972 cohort, Grasso and Shea (1979) found no significant effect of vocational education on wage rate of men. A similar result from the same data set is reported by Gustman and Steinmeier (1981) and Mertens and Gardner (1981). In Meyer's (1981) study, however, the positive effect is found in the first year after graduation for males when they specialize in trade and industry courses, and a negative effect is found if men specialize in business and office courses.

In the studies of the 1979 NLS new youth cohort data, neither Rumberger and Daymont (1982) nor Campbell et. al. (1981) found convincing evidence of consistent and significant positive effects of vocational education on earnings among young men. Again, only a positive effect is found if men obtained credits in the courses that had provided skills that were being used on their job (Rumberger and Daymont 1982).

This finding is consistent with the study of the 1973 NLS data, because the majority of men who took vocational courses are in the trade and industry field. Campbell et. al. (1981) found that concentration in vocational education was associated with slightly lower earnings per week for men. Using the same data, Gardner (1984) found that when the variables indicating the match between high school training and job characteristics are introduced, concentration in one vocational field yields positive return for men.

The evidence for females shows a more consistent pattern. Grasso and Shea (1979) found wage rates of women in business and office specialities are significantly higher than for women in other fields. Meyer (1981) and Gustman and Steinmeier (1981) similarly found significantly higher earnings (hourly and weekly) for women who took courses in business and office skills. Also, in the analysis of the new 1979 NLS data, Gardner reports that for women who specialize in business and office fields in high school and get clerical jobs, the return from vocational education is significantly positive.

In short, the findings from previous studies are summarized as follows:

> A significant impact of vocational education is found <u>less frequently</u> for males and <u>more frequently</u> for females and the match between the specialized vocational field in high school and the skill requirements of the job plays the key role.

The studies of the return from coursework, grades, and basic skills generally suggest the presence of a positive association between these variables and labor market success. Rumberger and Daymont (1982) found significant positive effect of additional academic courses on hourly wage rates and unemployment (in terms of weeks not unemployed) for both men and women. Meyer and Wise (1982) included class rank, standardized test score, and years of schooling in a wage and weeks-worked equation. The estimation result shows that, in a wage equation, class rank is marginally significant, and both test score and years of schooling have positive significance, and in weeks-worked equation all three variables have significant positive effects.

The impact of high school work experience is studied by Meyer and Wise. They included five dummy variables for weekly work hours in high school in weeks worked regressions. The effect of work experience on weeks worked in the first year after graduation is significantly positive when students worked more than 11 hours per week, and the effect increases with work hours.

In this study, the effects of the three aspects of high school experience on labor market outcomes are analyzed by using more detailed data than the previous studies. Again, the three measures used in describing curriculum are coursework in basics (mathematics and English), other academic coursework, and vocational education. Also, academic achievement and the levels of vocational and basic skills are measured separately. We use grade point average as a measure of performance in overall coursework and distinguish two vocational fields--business-office and trade-technical. In addition to these variables, the standardized test score is used as an independent measure of basic skills' acquisition level. Unlike previous studies, our analysis is focused on relatively a short period.

The outline of the rest of the paper is as follows. Section two describes the the HSB 1980 senior cohort data and the constructions of the variables used in the analysis are described. The time profile of earnings is analyzed by the simplied multivariate regression model described in Section Three.

The results from the earnings regressions suggest interesting time patterns: work experience in high school has large positive effects on the labor market outcomes right after high school, but its importance diminishes over the next 18-month period. On the other hand, effects of basic skills and vocational education increase over the observed period.

The findings from the analysis of earnings are more closely examined by looking at the two components of earnings, wage rate and work hours. In Section Four we discuss and examine the possible biases caused by the truncation in work hours and the unobservability of wage rate when the samples are out of work. The two-equation model of selectivity in wage rate and work hours is introduced and the estimation method proposed by Heckman (1978) is applied to average wage and work hours data. The results indicate that the use of traditional estimation method--ordinary least squares--causes serious biases in the estimates. Heckman's method is then applied to the longitudinal data of wage and work hours. The wage and work hours equations are estimated for successive periods and the time profile of the impact of high school experience is examined.

Finally, a summary and conclusions are presented in Section Five. Appendices included offer a technical description of Heckman's two-step estimation method and the part of the survey questionaire from which wage, hours, and earnings data are created.

The Data

Two waves of High School and Beyond (HSB) 1980 senior cohort data are analyzed. The first wave of data collection occured in March and April of 1980 while the students were seniors in high school. The second wave of data collection was conducted in the spring of 1982, nearly 2 years after graduation from high school. The first wave contains various detailed measures of education and grades in school and work experience as well as students' family background, attitudes toward work, locus of control, family orientation and other value scores. Also, at the time of the first wave survey, all respondents took standardized tests on three subjects, mathematics, reading, and vocabulary. These tests provide measures of the level of the basic skills which are comparable across respondents. The second wave contains a complete history of jobs held since 1980 and post high school educational experiences and earnings. Three measures of the respondents' labor market success--earnings, hours worked per week, and average hourly wage rate during the 21-month period between June 1980 and February 1982--are obtained from the second wave survey.

The original survey contains total observations of about 12,000 seniors. The subsample of this group was selected for this study by applying the following criteria: respondents had to have (1) graduated or left high school in May or June 1980 and (2) not attended school or college full time at any time between June 1980 to February 1982.

This reduced the sample size to 4,300. We then selected samples which have all three measures of labor market performance. This reduced the female samples to about 1,200 and the male samples to about 900.

We divided the 21-month period into 4 subperiods: summer (June 1980 - August 1980) and the next three 6-month periods (September 1980 - February 1981, March 1981 - August 1981, and September 1981 - February 1982).

Table 4.1 shows the time profile of high school graduates weekly work hours, wage rate, and earnings over these four periods. In the first period, which is the first summer after graduation, a very high proportion of students--(29 percent of male and 42 percent of female--did not work at all, but in the subsequent 18 month period these ratios declined to 15-17 percent for males and 25-29 percent for females. This observation indicates that a substantial portion of students spend the first summer after high school and vacation or shopping around for work, but do not start working in an actual job. After the summer, however, the majority of the youth settled down, in

TABLE 4.1

DESCRIPTIVE STATISTICS
WEEKLY WORK HOURS,
HOURLY WAGE, AND WEEKLY EARNINGS

	Male		Female		Not Worked	
	Mean	Standard Deviation	Mean	Standard Deviation	Male	Female
Weekly Work Hours[1]						
Period 1 (6/80 - 8/80)	33.84	(12.28)	28.95	(12.11)	29%	42%
Period 2 (9/80 - 2/81)	35.87	(11.67)	29.91	(12.50)	17%	29%
Period 3 (3/81 - 8/81)	36.99	(11.31)	30.94	(12.11)	15%	25%
Period 4 (9/81 - 2/82)	37.47	(11.19)	30.88	(12.51)	15%	26%
Total Period (6/80-2/82)	32.95	(12.28)	25.71	(12.59)	9%[2]	16%[2]
Hourly Wage[1]						
Period 1 (6/80 - 8/80)	4.10	(1.50)	3.58	(1.04)		
Period 2 (9/80 - 2/81)	4.34	(1.62)	3.86	(1.50)		
Period 3 (3/81 - 8/81)	4.70	(1.83)	4.07	(1.47)		
Period 4 (9/81 - 2/82)	5.11	(2.15)	4.40	(1.93)		
Total Period (6/80-2/82)	4.64	(1.85)	4.02	(1.60)		
Weekly Earnings						
Period 1 (6/80 - 8/80)	99.2	(87.7)	59.8	(64.3)		
Period 2 (9/80 - 2/81)	129.4	(93.1)	82.1	(74.5)		
Period 3 (3/81 - 8/81)	148.4	(101.6)	94.6	(77.7)		
Period 4 (9/81 - 2/82)	162.4	(111.0)	100.9	(87.7)		
Total Period (6/80-2/82)	150.3	(100.6)	94.3	(75.7)		

1. For those who worked.

2. Not worked through the observation period, not average.

terms of work status, and the labor participation rate for the population was quite stable over the next 18-month period.

During the 21-month period, wage and work hours for those who worked show a steady growth pattern. The hourly wage for males grew from $4.10/hour to $5.11/hour and for females, from $3.58/hour to $4.40/hour. Total average hours worked a week for males increased from 33.8 hours to 37.5 hours, but for females the average hours worked a week did not change much (29 hours to 31 hours).

A remarkable common pattern in wage rates and work hours is that there appears to be no association between the hours worked and wage rate. For both female and male, the product of the average wage and the average hours worked per week are very close to average earnings, indicating that for those who worked, wage rate and work hours are uncorrelated in the same period. This pattern is consistent for both males and females through the entire 21-month period.

The study focuses on how these measures of early labor market success are influenced by the high school experience, coursework in basics (English and mathematics), other academic courses, and vocational education, performance in the coursework, level of basic skills, and work experience in high school.

The variables describing high school experience are defined below

Years of Courses Taken

Mathematics and English: Sum of years each of mathematics and English courses taken.

Other Academic: Sum of all the academic courses taken in years except English and mathematics.

Vocational: Sum of all the vocational courses taken in years.

Grades and Academic Test Scores

Grade Point Average: Average grade point so far in high school.

Grade, Trade & Technical: One if student took more than 2 courses in trade and technical fields and received average grade of A or B, zero otherwise.

Grade, Business & Office: One if student took more than 2 courses in the business and office field and received average grades of A or B, zero otherwise.

Test Score: Average standardized test score of mathematics, reading, and vocabulary.

Work Experience in High School

Wage in high school: Most recent hourly wage while working in high school, zero if not worked.

Never worked in high school: One if no work experience at all in high school, zero otherwise.

Work Hours, Senior: Weekly hours worked during senior school year.

Work Hours, Summer: Weekly hours worked in summer 1979.

Work Hours, Junior: Weekly hours worked in junior school year.

Worked, Summer Only: One if worked only in summer 1979, zero otherwise.

Psychology Scores

Locus of Control: Wave one locus of control composite psychological scale.

Self Concept: Wave one self concept composite psychological scale.

Work Orientation: Wave one work orientation on composite psychological scale.

Family Orientation: Wave one family orientation composite psychological scale.

Community Orientation: Wave one community orientation composite psycho logical scale.

Socio-Geographical and Other Variables

Suburb: Dummy for school in suburb.

Rural: Dummy for school in rural area (default is urban).

Physical Handicap: One if physically or behaviorly handicapped, zero otherwise.

Visual Handicap: One if visually handicapped, zero otherwise.

Race: White = 0, nonwhite = 1.

Hispanic: Hispanic = 1, nonhispanic = 0.

Age: Age as of May, 1980.

Family Income: Family income in thousand dollars.

Family Income Missing: Dummy for family income data missing.

The descriptive statistics of the variables are presented in Table 4.2.

Male and female high school graduates take similar numbers of courses in academic fields: aveage values are 4.6 to 4.7 years in mathematics and English and 4.2 to 4.3 in other academic fields and the variances in academic courses are rather small. Men take more vocational courses than women (2.9 against 2.4 years) and the variance is larger, too.

TABLE 4.2

HIGH SCHOOL
DESCRIPTIVE STATISTICS
EXPERIENCE AND BACKGROUND VARIABLES

Variables	Male Mean	Male Standard Deviation	Female Mean	Female Standard Deviation
Years of Courses Taken				
Math and English	4.70	(1.42)	4.63	(1.30)
Other Academic	4.23	(1.90)	4.35	(1.81)
Vocational	2.90	(2.30)	2.41	(1.85)
Grades and Academic Test Scores				
Grade Point Average	77.65	(6.78)	79.89	(7.16)
Grade, Trade & Technical	0.30	(0.46)	0.04	(0.20)
Grade, Business & Office	0.07	(0.27)	0.29	(0.45)
Test Score	48.46	(8.49)	47.31	(7.94)
Work Experience in H.S.				
Wage in High School	3.37	(0.90)	2.99	(1.04)
Never Worked in H.S.	0.04	(0.19)	0.08	(0.27)
Work Hours, Senior	13.97	(12.88)	9.68	(10.96)
Work Hours, Summer	27.93	(14.91)	18.69	(16.19)
Work Hours, Junior	16.60	(13.75)	11.00	(12.52)
Worked, Summer Only	0.14	(0.34)	0.15	(0.36)
Psychological Test Scores				
Locus of Control	-0.19	(0.67)	-0.19	(0.72)
Self Concept	0.02	(0.70)	0.12	(0.80)
Work Orientation	0.12	(0.64)	-0.14	(0.78)
Family Orientation	-0.04	(0.61)	0.07	(0.61)
Community orientation	0.08	(0.71)	0.01	(0.65)
Socio-Geographical and Other Var.				
Suburb	0.41	(0.49)	0.41	(0.49)
Rural	0.34	(0.47)	0.32	(0.47)
New England	0.04	(0.19)	0.04	(0.20)
South Atlantic	0.19	(0.39)	0.21	(0.41)
East South Central	0.08	(0.27)	0.07	(0.25)
West South Central	0.14	(0.35)	0.13	(0.34)
East North Central	0.17	(0.37)	0.17	(0.38)
West North Central	0.06	(0.24)	0.06	(0.23)
Mountain	0.07	(0.26)	0.06	(0.24)
Pacific	0.13	(0.33)	0.13	(0.34)
Physical Handicap	0.01	(0.11)	0.01	(0.11)
Visual Handicap	0.03	(0.17)	0.02	(0.14)
Race	0.40	(0.49)	0.43	(0.50)
Hispanic	0.25	(0.43)	0.23	(0.42)
Age	18.20	(0.58)	18.03	(0.58)
Family Income	19.02	(10.35)	17.41	(9.25)
Family Income Missing	0.06	(0.24)	0.10	(0.30)

Among vocational courses male students specialize in trade and technical fields whereas female students tend to take more business and office education courses and both do well in their specialized field. Thirty percent of males take more than 2 years of trade-technical courses and receive good grades but the percentage for females is only 4 percent. In business and office fields the relation is reversed. Twenty-nine percent of females take courses and receive good grades in business and office courses but for males it is only 7 percent.

The work experience in high school also shows a large difference between males and females. Males worked longer hours and received higher wages than females. In the junior through senior years, weekly work hours are 16.6 (junior), 27.9 (summer), and 13.97 (senior) for males. For females the figures are 11.0, 18.7, and 9.7, respectively. The difference in wage is nearly 40 cents per hour (13 percent).

The proportion of students who never worked during high school is consistent with work hours and wage. The proportion for female students is 8 percent which is twice as large as that for males.

Effects of High School Curriculum on Earnings Profile--Analysis of Duration Data

The impact of high school experience on students' labor market success varies over time, depending on which stage of the labor market in which the youth is. Skills that are important in getting jobs, such as know-how of job search techniques, good interviewing skills, verbal skills, and more, will certainly help students in the initial stage of the labor market experience. These skills, however, may not be as important as basic academic skills (mathematics and English), vocational training, or good work attitudes in later stages. Let us consider the student's performance in the labor market in time span of length "t" after high school. The students' labor market performance in the "t"th period is determined by the initial conditions at the time of graduation, and the labor market experience before the "t"th period.

The initial conditions are defined by such factors as work experience in high school, coursework in academic and vocational courses, grades, level of basic skills (in mathematics, reading, and vocabulary), attitude toward work, and psychological scores, as well as socioeconomic and demographic background variables. The labor market outcomes in the initial period after graduation are determined by these initial conditions and other random factors.

In the second and later periods, the outcomes will be determined by the experience in the previous periods and students' backgrounds. We should note that observed patterns of labor market outcomes over time will show positive serial correlation because of two reasons. First, due to construction of the data, the measures of the labor market outcomes--wages, work hours, earnings--should show positive serial correlation because once the students get the job they tend to stay in the same position for a certain period. This persistence of status exists regardless of the level of students' ability, skill, or other background factors. Second, the causal relationship between experience and performance, either favorable or unfavorable, will influence the student's aptitude for and attitude toward work through on-the-job training and other channels, which in turn affects students' performances in later periods. Once students start working on the particular job, they learn necessary skills on the job and develop an ability for that type of work. The labor market outcome in the "t"th period is determined by the result of interaction between students' experience and background. In this interactive process the factors that are important in the initial stage of labor market may not be as important as basic ability to learn, adapt, and apply new skills. The purpose of this section is to identify the time pattern of influence of high school education and various background variables on high school graduate's labor market outcomes.

Ellwood (1982) has pointed out the difficulty of separating the effect of education on labor market outcomes from the heterogeneity in the sample. When there are unobservable factors that influence both the students' labor market outcomes and their choice of curriculum and performance in high school, such as a taste for work or IQ, it is difficult to identify the true effect of education from the effect of unobservable factors in the absence of data on unobserved characteristics. What appears to be the effect of education may be in fact a combination of the pure effects of education and the result of heterogeneity. The effect of heterogeneity may be removed by estimating the model from time differenced data. This method is valid if the longitudinal data on the explanatory variables are available and change over time, and the unobservable effects are constant over time. Furthermore, comparing the two sets of estimates, one from the differenced model and the other from the model without taking difference, the presence of heterogeneity can be tested.

Unfortunately, in our data we are unable to estimate the differenced model because we have only one set of high school experience variables, and so, it is impossible to test heterogeneity. However, in our model we included the variables representing students' taste, attitudes toward work, other psychological scores, and a measure of ability (test scores), which are considered to be the main sources of the unobservable heterogeneity in the past studies. Including these variables in the regressions we may reasonably assume that the heterogeneity is not a serious problem in our analysis.

The relationship between high school experience and students' performance in the labor market is described by the following equation:

$$(1) \quad Y_{it} = X_i\beta_t + Z_i\alpha + U_{it}$$

$$i = 1, N, \; t = 1, T$$

The subscripts i and t refer to the "i"th individual and the "t"th time period, after graduation, respectively.

The explanatory variables are classified into two categories, X_i and Z_i. The coefficients corresponding to Z_i, α, are constant over time, but the coefficients for X_i, β_t, change with time. Consequently, we call β_t the time varying effects, and $\underline{\alpha}$ the time invariant effects. Distinction between the variables with time varying effects and the variables with time invariant effects are, of course, artificial and subject to empirical testing. However, the purpose of this study is to identify the time varying effect of high school education and other background variables after graduation and so we specify the variables pertaining to high school education as time varying factors and treat other control variables such as geographic region, suburb, rural, race, Hispanic dummies, age, and family income as time invariant factors.

The time periods are divided into the following four periods;

Time period 1	June 80 to August 80
Time period 2	September 80 to February 81
Time period 3	March 81 to August 81
Time period 4	September 81 to February 82

Time period 1 is the summer break right after graduation. Even though the samples included in the analysis do not attend school as full-time students, labor market behavior in summer time after graduation may quite well be different from the one in the subsequent periods. The next 18 months are divided into three 6-month periods.

Since the earnings data is constructed from monthly time series, we expect that the covariances between disturbance terms across time periods are non-zero (positive). Also, the magnitude of variance in each period may differ over time. We define the covariance matrix by the following equation:

(2) $\mathrm{Var}(\underline{U}_i) = \Sigma = [\sigma_{st}]$

$s, t = 1, \ldots 4$

The covariance matrix Σ is not restricted to be in any specific form and Σ is to be estimated. Also, we restrict the change in β_t so it is linear in the time period. That is, β_t is written as follows:

(3) $\beta_t = \beta_1 + (t-1)\cdot\mu \quad t = 2, 3, 4$

The coefficient in the first period and the time varying effects change at a constant rate μ.

Substitution of equation three into equation one yields the following:

(4) $Y_{it} = X_i(\beta_1 + (t-1)\cdot\mu) + Z_i\alpha + U_{it}$

$i = 1, \ldots N$

$t = 1, \ldots 4$

The model in equation four is estimated as the seemingly unrelated regression system with linear cross equation restrictions. There are four equations in the system. Each one of them corresponds to one of four time periods.

Estimation results

The system in equation four is estimated by Zellner's Feasible (one step) GLS method. The estimated covariance matrices of the residuals are given in Table 4.3 for both male and female. As expected, the correlations between time periods are all positive and have higher value for adjacent periods. Also, the variances of residual terms (diagonal elements) increase with time.

Table 4.

TIME PROFILE OF EARNINGS
(Residual Variance from Estimates)

	Female			
	Period 1	Period 2	Period 3	Period 4
Period 1	[illegible]			
Period 2	2193	[illegible]		
Period 3	[illegible]	2771	5013	
Period 4	1771	3241	4485	6357

	Male			
	Period 1	Period 2	Period 3	Period 4
Period 1	6237			
Period 2	[illegible]	[illegible]		
Period 3	3924	6747	[illegible]	
Period 4	[illegible]	[illegible]	7925	[illegible]

TABLE 4.[illegible]

ESTIMATION RESULT--THE PROFILE OF EARNINGS[1]

	Male				Female			
	Time Varying Effect				Time Varying Effect			
	Coefficient in 6/80 - 6/80		Change in Effect		Coefficient in 6/80 - 6/80		Change in Effect	
	Coeffi.	t-Ratio	Coeffi.	t-Ratio	Coeffi.	t-Ratio	Coeffi.	t-Ratio
Test Score	.177	(.[illegible]4)	.417**	(2.[illegible]4)	.[illegible]2**	(2.24)	.117	(.97)
Vocational Courses[2]	2.14[illegible]**	(2.1[illegible])	.69[illegible]	(1.1[illegible])	1.[illegible]5[illegible]	(1.17)	1.[illegible]3**	(2.14)
English, Mathematics	.72[illegible]	(.34)	1.10[illegible]	(1.20)	- .051	(- .56)	- .256	(- .37)
Other Academic	-1.23[illegible]	(- .[illegible]1)	-1.[illegible]	(-1.34)	-1.[illegible]*	(-1.77)	- .[illegible]75*	(-1.[illegible]7)
Grade, Trade & Technical	4.897	(.71)	.631	(.22)	-5.031	(- .59)	-1.[illegible]03	(- .46)
Grade, Business & Office	.12[illegible]	(.01)	2.12[illegible]	(.4[illegible])	9.09[illegible]**	(2.14)	- .[illegible]	(- .43)
Grade Point Average	- .450	(-1.05)	- .136	(- .74)	.25[illegible]	(.99)	.130	(1.06)
Work Experience	.[illegible]32***	(9.55)	- .[illegible]03	(- .[illegible])	.575***	([illegible].43)	- .0[illegible]	(- .[illegible])
Locus of Control	[illegible].894**	(2.12)	.921	(.51)	5.037*	(1.95)	3.536***	(2.95)
Self Concept	-1.[illegible]91	(- .4[illegible])	-1.7[illegible]	(-1.[illegible]1)	-[illegible].[illegible]53	(-1.30)	-1.264	(-1.27)
Work Orientation	-6.979*	(-1.87)	.967	(.53)	1.766	(.83)	2.005**	(2.01)
	Time Invariant Effect				Time Invariant Effect			
	Coefficient	t-Ratio			Coefficient	t-Ratio		
Suburb	15.340**	(2.46)			- 3.476	(- .87)		
Rural	14.7[illegible]7**	(2.17)			-10.[illegible]4***	(-2.59)		
Race	-20.6[illegible]***	(-3.65)			-16.495***	(-4.53)		
Hispanic	-10.[illegible]5*	(-1.6[illegible])			4.951	(1.26)		
Age	10.912**	(2.46)			- 5.854**	(-2.13)		
Family Income	.[illegible]*	(1.[illegible]3)			.071	(.41)		
Family Income Missing	6.232	(.61)			2.537	(.52)		

1. Due to program limitation, the following variables are excluded from the equation: wage in H.S., never worked in H.S., worked summer only, family orientation, community orientation, physical handicap and visual handicap.

2. The sum of work hours in senior, summer, or junior.

These indicate that there is a substantial efficiency gain in estimating the system by the seemingly unrelated regressions technique.

The estimation results are presented in Table 4.4. The number of observations is 905 for male samples and 1,205 for female samples. The result is discussed separately for males and females.

Male

In male samples, the most significant effect in the first period is work experience in high school (junior through senior years), and the estimated coefficients suggest that 20 hours of weekly work in school from junior to senior years will increase weekly earnings by nearly $50 in the first period. However, the effect of work during school does not widen the earnings difference in the subsequent periods.

Among curriculum variables, only vocational education shows a strong significant effect on earnings. The coefficient estimates suggest that a 3-course year of vocational education raises weekly earnings by $8.80 in the period right after graduation and the positive effect of vocational education seem to persist over the next 18-month period. The point estimate of time varying effect is slightly larger than standard errors and by the end of last observation period (21 months after graduation), the return from vocational education increased by 70 percent compared to the initial period. The effect of coursework in English and mathematics is negligible in the initial period, but the change in effect is positive and nearly significant at the 10-percent level.

None of the grade variables are significant in the first period and they stay insignificant over the next 18 months. The measure of basic skills, and average test scores has no significant effect in the initial period, but the change in effect over time is positive and statistically significant at the 5-percent level. The point estimate of the magnitude of the effect at the end of a 21-month period is 1.428. This implies that the one standard deviation (8.5) increase in test score raises weekly earnings by $12.

Among psychological score variables, the locus of control (sense of control over one's own destiny) has a large positive effect in the initial period, but work orientation has negative effects. These indicate that students who prefer to work rather than study while they are in high school, in fact, do poorly in post high school labor market. On the other hand, students with a strong sense of responsibility and positive attitude toward school and life are successful after graduation.

Female

The effect of work experience in high school for the female sample shows the same pattern as in the male sample. The initial effect of work while in school is significantly positive and its magnitude is large. Twenty hours of work through the junior to senior years, including summer work, predicts increasing weekly earnings by $34.5 (57 percent) in the initial period. In the subsequent periods, however, the effect is gradually declining, and so relative importance of work experience in high school diminishes over time.

Among curriculum variables, vocational courses have a significantly positive time varying part, but contrary to males, the initial effect is not significant. The coursework in English and mathematics is insignificant in both initial and time varying parts. On the other hand, unlike males, grades in business and office coursework has significant positive effect right after graduation; getting good grades in business and office courses increases weekly earnings by $9 (15 percent), but the effect for females seems to decrease over the next 18-month period. Also, the grade point average shows positive initial and lasting effect over time but the standard errors for these estimates are close to one, implying that the significance level of the effect is around 30 percent.

Two psychological score variables, center of locus and work orientation, showed strong positive effects. Especially, the effect of center of locus is significant in the initial period and increases over the observation periods. At the end of the observation period its effect triples compared to the initial period. The basic skills level is found to be very important for female students. The point estimates for the initial and time varying effects are both positive and the magnitude of the former is significantly different from zero. The estimated coefficient suggests that one standard deviation increase in average standardized test score is associated with $4.50 increase in weekly earnings in the initial period and the effect increases to $7.15 by the end of the 21-month period.

To summarize the major findings in this section;

- Work experience in high school raises students' earnings in the initial period right after graduation, but the effect diminishes and its relative importance declines over time.

- Importance of level of basic skills (reading, vocabulary, and mathematics) increases over the 2-year period while the amount of coursework in mathematics and English per se isn't important.

- Vocational training in high school significantly increases earnings right after high school and the positive impact increases over the next 2 years. By the end of the 2-year period, three units of high school vocational education raise weekly earnings by about 10 percent for both male and female.

- When the level of basic skills acquisition is controlled, grades in academic and vocational courses appear to be significant for males and marginally significant for females. The exception is female's grades in business and office courses. It has a large effect in the beginning but the effect diminishes in the subsequent periods.

The above observed patterns in earnings will be examined more closely by looking at the two components of earnings, wage rate and work hours, in the next section.

Impact of High School Experience on Work Hours and Wage Rate

Introduction

The two measures of labor market performance, wage rate and work hours, and their relationship between high school experience are analyzed in this section. Labor market outcomes of youth workers right after graduation from high school are determined by the combinations of various factors.

High school graduates' job opportunities are limited and the majority of jobs fall between two extremes. The first are low-skill jobs that require no or very little training time. Typical examples are fast food chain workers, gasoline station attendants, janitors, and dishwashers. These jobs pay the minimum wage or close to the minimum wage and there is little chance of getting higher wages if someone stays in the same job. The second is the one that requires higher skill and pays higher wages when workers are fully trained, but substantial training is required to become a skilled worker. Youth workers who started working in this type of job without previous relevant training typically spend several months to a few years in on-and off-the job training. Salesman, craftsman (such as carpenters, electricians, mechanics, and painters), operatives, and secretaries, though their skill requirements may differ by various extents, belong to this category. During the training period workers pay for training by accepting a low wage. In both cases the observed wages in the early periods, are close to the minimum wage but a time profile of wage should be quite different.

Another aspect of low wage rate is that in the early stages of the labor market experience youth workers "shop around" for jobs until they settle in one occupation. The job-search process may take quite long and during the period of searching they accept low wage rates. In addition, nonemployment in the teenage years may be the result of either weak work attacnment or a voluntary decision to enjoy leisure instead of work. The resulting inexperience in the labor market will lead to a low wage rate and less work hours.

We expect that experience in high school, academic coursework, vocational education, level of basic skills at the time of graduation, and work experience have a positive impact on students' post-high school labor market performance. These high school experiences help students in preparing for the world of work by learning the necessary skills to get a job, to perform task on the job, and to keep a job once they get one. Differences in wage rate and work hours, and their time profile, represent differences in characteristics and high school experiences of youth workers.

The outline of the rest of this section is as follows. As a preliminary approach, the equations for average work hours and wage rate are estimated by two methods, the OLS and the limited dependent variable technique. The comparison of the two estimates show that there are substantial differences in the estimates between the two. Based on this result, the longitudinal data of work hours and wages are analyzed by the limited dependent variable technique. The last subsection discusses the estimation results for the longitudinal data on work hours and wages.

Analysis of Average Work Hours and Average Wage

The average hourly wage rate and the average weekly work hours during the 21-month period after graduation are regressed on the variables measuring high school work experience, academic and vocational education, grades, test scores in basic skills, and attitude toward work and responsibility, after controlling for students' socio-economic variables, race, Hispanic origin, and census regions.

Average wage is defined as the total earnings during the period divided by the total work hours. In our sample, however, about 10 percent of males and 15 percent of females did not work at all and so wage rates for these samples are not defined. Also, there is a mass point in distribution of work hours at zero.

Selectivity and truncation in dependent variables cause serious bias in parameter estimate when the observed dependent variables are regressed on the explanatory variables using only a subset of total sample. In dealing with the bias due to selectivity and truncation, we employed the two-step estimation technique proposed by Heckman (1978). In the first step the weekly work hours equation is estimated from the entire samply by the Tobit method, and in the second step the selectivity bias is corrected by using the predicted inverse Mills ratio calculated from the first step estimates (see Appendix A).

Table 4.5 and table 4.6 show the estimated coefficients for work hours and wage rate equations, respectively. The first and the third column entries in the tables show the OLS estimates based on sample with positive work hours (nonlimit sample). While the second and the fourth column entries are those based on Tobit (wage equation) and on Heckman's two step method (work hours equation).

Comparison of the estimates without the correction for selectivity/ truncation and those after the correction reveal that the biases are indeed serious. In the work hours equation the absolute magnitudes of the coefficients by the maximum likelihood Tobit are in general larger than the ones based on the OLS estimates for nonlimit sample. The estimates for wage equation also show substantial difference between the two estimation methods. Further, the coefficient corresponding to Heckman's lambda is significantly

TABLE 4.[illegible]

ESTIMATION RESULT
AVERAGE WEEKLY WORK HOURS
IN JUNE 80 TO FEBRUARY 82

	Male				Female			
	Nonlimit OLS		Tobit		Nonlimit OLS		Tobit	
	Coeffi.	t-Ratio	Coeffi.	t-Ratio	Coeffi.	t-Ratio	Coeffi.	t-Ratio
Wage in High School	1.125*	(1.79)	.[illegible]	(.34)	.[illegible]	(1.46)	1.474*	(2.21)
Never worked in H.S.	-1.361	(- .42)	-4.755	(-1.24)	-1.564	(- .72)	-1.454	(- .58)
Work Hours, Senior	.100***	(2.6[illegible])	.111**	(2.21)	.096**	(2.23)	.100***	(3.59)
Work Hours, Summer	.118***	(3.49)	.169***	(3.99)	.111***	(3.47)	.132***	(3.81)
Work Hours, Junior	.023	(.66)	.069	(1.59)	.[illegible]	(.06)	.0137	(.45)
Worked, Summer Only	.357	(.25)	.548	(.32)	-4.098	(-3.33)	-4.113***	(-2.87)
Test Score	.[illegible]	(1.28)	.225***	(2.63)	.012	(.19)	.130*	(1.92)
Vocational Courses	.455**	(2.20)	.865***	(3.34)	.639***	(2.71)	.834***	(2.95)
English, Mathematics	- .073	(- .22)	.053	(.20)	.012	(.03)	- .348	(- .85)
Other Academic	- .115	(- .44)	- .382	(-1.20)	- .693***	(-2.78)	- .603**	(-2.06)
Grade, Trade & Technical	.138	(.13)	-1.364	(-1.04)	-2.776	(-1.53)	-2.500	(-1.10)
Grade, Business & Office	-1.997	(-1.27)	-1.242	(- .62)	.390	(.42)	.850	(.75)
Grade Point Average	- .117*	(-1.73)	- .181**	(-2.19)	.066	(1.11)	.032	(1.10)
Locus of Control	1.259*	(1.90)	1.866**	(2.30)	1.348**	(2.30)	3.019***	(4.37)
Self Concept	- .740	(-1.21)	.34[illegible]	(.06)	- .658	(-1.34)	-1.279	(-2.44)
Work Orientation	-1.071	(-1.56)	-1.475*	(-1.77)	1.047**	(2.12)	1.295**	(2.21)
Number of Observations	816		905		1014		1205	

Note: Numbers in parentheses are t-values. *, **, and *** indicate that in the both side test, * -- significant at 10% level, ** -- significant at 5% level, ***-- significant at 1% level.

Other control variables included in the regressions are family orientation score, community orintation score, dummies for suburb, rural, race and Hispanic, age, family income, dummy for family income missing, handicap dummies, and eight dummies for census regions.

TABLE 4.[illegible]

ESTIMATION RESULT
AVERAGE WAGE RATE
IN JUNE 80 TO FEBRUARY 82

	Male				Female			
	Nonlimit OLS		Heckman's 2nd Step		Nonlimit OLS		Heckman's 2nd Step	
	Coeffi.	t-Ratio	Coeffi.	t-Ratio	Coeffi.	t-Ratio	Coeffi.	t-Ratio
[illegible] in High School	.[illegible]***	([illegible].12)	.[illegible]***	([illegible].[illegible]2)	.[illegible]2	(1.[illegible]2)	.[illegible]	([illegible])
Never Worked in U.S.	1.443***	(2.[illegible]0)	.762	(1.29)	.4[illegible]9	(1.5[illegible])	.[illegible]*	(1.[illegible]3)
Work Hours, Senior	- .[illegible]3	(- .5[illegible])	.[illegible]	(.[illegible])	- .[illegible]	(- .[illegible]4)	- [illegible]	(- [illegible])
Work Hours, Summer	.005	(.56)	.014**	(2.07)	.005	(1.30)	.0[illegible]2	(.32)
Work Hours, Junior	.[illegible]1[illegible]***	([illegible].[illegible]1)	.[illegible]1[illegible]***	(3.[illegible]0)	.[illegible]2	(.2[illegible])	.[illegible]1	(.3[illegible])
Worked, Summer Only	.215	(1.0[illegible])	.22	(1.09)	- .109	(- .64)	.004	(.02)
Test Score	- .[illegible]	(- .[illegible])	.[illegible]	(.[illegible]6)	- .[illegible]	(- .7[illegible])	- .[illegible]9	(-[illegible])
Vocational Courses	.010	(.31)	.047	(1.29)	.029	(.[illegible]8)	.01[illegible]	(.[illegible]2[illegible])
English, Mathematics	.[illegible]	(1.15)	.065	(1.[illegible])	.[illegible]	(1.27)	.[illegible]	(1.[illegible])
Other Academic	- .042	(-1.0[illegible])	- .057	(-1.43)	- .02[illegible]	(- .61)	- .015	(- .42)
Grade, Trade & Technical	.45[illegible]***	(2.[illegible])	.[illegible]**	([illegible].[illegible]7)	- .0[illegible]	(- .14)	.024	(.1[illegible])
Grade, Business & Office	.4[illegible]**	(2.03)	.340*	(1.82)	.280**	(2.16)	.26[illegible]**	(2.0[illegible])
Grade Point Average	- .006	(- .[illegible]2)	- .[illegible]1[illegible]	(-1.33)	.011	(1.34)	.01[illegible]	(1.[illegible])
Locus of Control	.054	(.[illegible]3)	.17[illegible]	(1.53)	.[illegible]	(1.[illegible])	- .027	(- .2[illegible])
Self Concept	- .10[illegible]	(-1.13)	- .[illegible]9	(-1.0[illegible])	- .10[illegible]	(-1.5[illegible])	- .0[illegible]2	(-1.1[illegible])
Work Orientation	- .064	(- .51)	- .13[illegible]	(-1.26)	.059	(1.06)	.035	(.50)
Lambda	---		5.122**	(2.0[illegible])	---		-1.24[illegible]	(-[illegible].[illegible])
Number of Observations	816		905		1014		12[illegible]5	

Note: Numbers in parentheses are t-values. *, **, and *** indicate that in the both side test, * -- significant at 10% level, ** -- significant at 5% level, ***-- significant at 1% level.

Other control variables included in the regressions are family orientation score, community orientation scores. Dummies for suburb, rural, race and Hispanic, age, family income, dummy for family income missing, and eight dummies for occupations.

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different from zero for males, and for females though it is not significant at the 10-percent level, the point estimate is larger than its standard errors.

Estimates based on Tobit and Heckman's second step suggest that the following relations exist:

- Basic skills have a significant positive effect on work hours for both males and females but its impact on wage rate is negligible.

- Among high school curriculum variables, only vocational education has a significant positive effect on work hours and the magnitudes of its impact is about the same for both male and female. One additional course in vocational education increase weekly work hours by 0.85 hours.

- Grades in academic and vocational courses do not affect the work hours but good grades in vocational courses tend to raise wage rates.

- Work experiences in high school appear to have a strong effect on work hours for both sexes. However, its effect on wage rate is significant for males only.

Finally, the estimates of the coefficients corresponding to the inverse Mills ratios suggest the following:

- Longer work hours are associated with higher wage rates for males, and the association is weakly negative for females.

The above observed patterns of the effects of high school experience on the wage rate and work hours are about the average values over the 21-month period. As the examination of earnings data suggests, the impact of experience in high school is not uniform over the observation period. Effects of some variables, work experience, and grades appear to be diminishing over the observation period while the effects of vocational education and level of basic skills reinforce themselves over the period. Time patterns of these effects will be examined further by looking at the longitudinal data on the two components of earnings, wage rate and weekly work hours.

Analysis of Time Profile of Work Hours and Wage Rates.

In this subsection the longitudinal data of wage rate and work hours are analyzed by applying Heckman's two-step method for each period.

The basic framework of the theoretical model is that the outcomes in the "t"th period after graduation are determined as the function of high school experience and labor market experience before the "t"th period after graduation. Let Y_t denote the outcome in the "t"th period and X denote background variables. The general form of the model is written as follows:

$$(5)\ Y_t = X\beta_t + \sum_{s=1}^{t-1}\alpha_{ts}Y_s + U_t \qquad t = 2, \ldots 4$$

In the first period after graduation the outcomes are the function of high school experience only:

$$(6)\ Y_1 = X\beta_1 + U_1$$

The recursive model in equations five and six can be transformed by sequential substitutions, and outcomes in the observation periods can be written as the function of high school experience variables only. We call the model after the substitution, the reduced model. The reduced model is written as follows:

$$(7)\ Y_t = X\beta_t^* + V_t \qquad t = 1, \ldots 4,$$

$$\beta_1^* = \beta_1$$

$$\beta_t^* = \beta_t + \sum_{s=1}^{t-1}\alpha_{ts}\beta_s^* \qquad t = 2, 3, 4.$$

The coefficient vector β_t^* captures the total effect of high school experience at the "t"th period after graduation. The total effect is expressed as the sum of β_t, which is the direct effect at the time period t, and the indirect effects through labor market outcomes.

Two versions of the model, the reduced form and the recursive form, are estimated. The dependent variables are wage rates and work hours and the right hand side variables are high school experience variables and lagged values of weekly work hours. We excluded the lagged wage rates from the explanatory variables because wage rates are undefined if the student did not work in the period. Also we note the models in all three eauations are written in terms of latent variables for work hours and wage rates. The specific form of the hours equation for recursive model is written as follows:

$$H_t^* = X\beta_{Ht} + \sum_{s=1}^{t-1}\alpha_{Hts}H_s + U_{Ht}$$

The realized, H_s, is the value of work hours at time S and H_t^* is the latent variable for work hours. If H_t^* is positive the value of the latent variable are realized value of work hours coincide, and the observed work hours are zero, if and only if the latent variable takes non-positive value.

Similarly, the wage equation is written as follows:

$$W_t = X\beta_{Wt} + \sum_{s=1}^{t-1}\alpha_{Wts}H_s + U_{Wt}$$

W_t is the wage rate at time t. Wage rate is observable if the person works in the period, but it is not observed if work hour is zero. Again, the work hours on the right hand side are the <u>realized</u> value of the work hours.

For both the recursive and reduced forms the work hour equation is estimated by the maximum likelihood Tobit and the wage equation is estimated by Heckman's two-step method using the predicted value from the Tobit estimates.

The Estimation Results

The estimation results for both the reduced model and the recursive model are presented in Tables 4.7 to 4.10. The results are discussed by focusing on the effects of basic skills, vocational education, and work experience.

Effect of Basic Skills

The impact of basic skills--mathematical, verbal, and writing skills--is measured by the coefficients for average test scores. For both males and females the total effects on work hours are significantly positive and the estimates are quite stable over the observation period. Estimated coefficients suggest the following: the one standard deviation increase (8.5 for male and 7.9 for female) in test score predicts increases in weekly work hours by 2.1 to 2.7 hours for males and 1.2 to 2.3 hours for females. However the wage rate seems to be not responsive to the basic skills. The coefficients for test scores are insignificant in all periods in both recursive and reduced

TABLE 4.7

TIME PROFILE OF WORK HOURS AND WAGE
MALE--REDUCED FORM ESTIMATES[1]

NUMBER OF OBSERVATIONS = 893

Work Hours Tobit	Period 1		Period 2		Period 3		Period 4	
Wage in High School	2.849**	(2.27)	.453	(.44)	.111	(.11)	.838	(.86)
Never Worked in H.S.	1.783	(.29)	-9.562*	(-1.94)	-6.536	(-1.40)	-2.528	(- .55)
Work Hours, Senior	.184**	(2.51)	.136**	(2 24)	.110*	(1.89)	.110*	(1.91)
Work Hours, Summer	.282***	(4.28)	.160***	(2.90)	.184***	(3.58)	.181***	(3.53)
Work Hours, Junior	.194***	(2.90)	.100*	(1.81)	.031	(.58)	.069	(1.31)
Worked, Summer Only	-3.81[illegible]	(-1.44)	2.775	(1.29)	1.046	(.51)	.725	(.35)
Test Score	.3[illegible]**	(2.60)	.241**	(2.38)	.264***	(2.73)	.268***	(2.79)
Vocational Course	.233	(.58)	.908***	(2.77)	1.061***	(3.38)	1.002***	(3.20)
English, Mathematics	- .343	(- .54)	.178	(.34)	- .023	(- .05)	.174	(.35)
Other Academic	- .062	(- .13)	- .503	(-1.24)	- .571	(-1.47)	- .342	(- .89)
Grade, Trade & Technical	- .004	(- .00)	- .746	(- .45)	-1.215	(- .76)	-3.289**	(-2.07)
Grade, Business & Office	-1.280	(- .42)	-1.543	(- .61)	- .545	(- .23)	-2.008	(- .85)
Grade Point Average	- .133	(-1.03)	- .228**	(-2.17)	- .175*	(-1.74)	- .244**	(-2.43)
Locus of Control	2.337*	(1.86)	1.569	(1.62)	2.603***	(2.65)	1.816*	(1.86)
Self Concept	.311	(.26)	.606	(.63)	.383	(.41)	- .684	(- .74)
Work Orientation	- .798	(- .62)	-2.307**	(-2.18)	-1.496	(-1.48)	-1.647	(-1.63)
Wage Rate Heckman's 2nd Step	**Period 1**		**Period 2**		**Period 3**		**Period 4**	
Wage in High School	.554***	(4.66)	.454***	(4.86)	.427***	(4.19)	.431***	(3.50)
Never Worked in H.S.	1.339**	(2.46)	.341	(.48)	.768	(1.16)	1.653**	(2.55)
Work Hours, Senior	- .004	(- .65)	.0002	(.03)	.004	(.62)	.005	(.66)
Work Hours, Summer	.017*	(1.67)	.013*	(1.76)	.018**	(2.19)	.016*	(1.74)
Work Hours, Junior	.012*	(1.78)	.010*	(1.88)	.008	(1.54)	.016**	(2.38)
Worked, Summer Only	- .412*	(-1.71)	.060	(.30)	.166	(.78)	.126	(.51)
Test Score	- .003	(- .24)	- .001	(- .08)	.006	(.49)	.001	(.07)
Vocational Course	.057*	(1.96)	.046	(1.19)	.066	(1.48)	.055	(1.13)
English, Mathematics	.050	(1.07)	.040	(.87)	.049	(.96)	.072	(1.19)
Other Academic	- .047	(-1.32)	- .032	(- .84)	- .046	(-1.07)	- .033	(- .70)
Grade, Trade & Technical	.178	(1.21)	.304**	(.06)	.450***	(2.74)	.445**	(2.07)
Grade, Business & Office	.141	(.67)	.274	(1.23)	.256	(1.09)	.497*	(1.73)
Grade Point Average	- .014	(-1.45)	- .013	(-1.13)	- .007	(- .64)	- .007	(- .45)
Locus of Control	.170	(1.54)	.104	(1.01)	.271**	(2.07)	.232*	(1.72)
Self Concept	- .162*	(-1 90)	- .176**	(-2.05)	- .210**	(-2.24)	- .207*	(-1.81)
Work Orientation	- .112	(-1.17)	- .158	(-1.39)	- .033	(- .29)	.035	(.26)
Lambda	1.794	(1.12)	2.850	(1.22)	5.146	(1.64)	3.304	(1.01)

* significant at 10% level (two sided)
** significant at 5% level (two sided)
*** significant at 1% level (two sided test)
t values in parentheses

1. See note in table 3.A.

TABLE 4.8

TIME PROFILE OF WORK HOURS AND WAGE
FEMALE--REDUCED FORM ESTIMATES

NUMBER OF OBSERVATIONS = 1205

Work Hours Tobit	Period 1		Period 2		Period 3		Period 4	
Wage in High School	3.488***	(3.08)	2.289**	(2.46)	1.170	(1.32)	1.170	(1.29)
Never Worked in H.S.	5.599	(1.29)	-4.81	(- .14)	-4.385	(-1.31)	-3.139	(- .92)
Work Hours, Senior	.346***	(4.20)	.253***	(3.65)	.191***	(2.87)	.133*	(1.95)
Work Hours, Summer	.338***	(5.81)	.107**	(2.23)	.153***	(3.31)	.142***	(3.01)
Work Hours, Junior	- .040	(- .58)	.079	(1.38)	.001	(.01)	.028	(.50)
Worked, Summer Only	-6.204**	(-2.51)	-5.354***	(-2.66)	-3.854**	(-2.01)	-4.900**	(-2.50)
Test Score	.287**	(2.38)	.147	(1.47)	.165*	(1.72)	.215**	(2.20)
Vocational Course	.219	(.46)	1.245***	(3.17)	1.313***	(3.49)	.964**	(2.51)
English, Mathematics	-1.256*	(-1.85)	- 2.78	(- .49)	- .383	(- .71)	- .652	(-1.20)
Other Academic	- .163	(- .33)	- .551	(-1.34)	-1.017***	(-2.58)	- .981**	(-2.43)
Grade, Trade & Technical	-3.761	(-1.00)	-3.112	(- .99)	-3.818	(-1.27)	-1.598	(- .52)
Grade, Business & Office	2.431	(1.29)	1.583	(1.01)	.316	(.21)	.565	(.37)
Grade Point Average	.059	(.50)	.028	(.29)	.089	(.96)	.114	(1.21)
Locus of Control	2.165*	(1.85)	3.037***	(3.15)	3.755***	(4.07)	4.440***	(4.71)
Self Concept	-1.186	(-1.23)	-1.618**	(-2.04)	-1.755**	(-2.32)	-1.625**	(-2.11)
Work Orientation	1.482	(1.50)	1.157	(1.42)	1.224	(1.57)	2.131***	(2.67)
Wage Rate Heckman's 2nd Step	**Period 1**		**Period 2**		**Period 3**		**Period 4**	
Wage in High School	.265***	(2.78)	.022	(.23)	.105	(1.34)	.184*	(1.79)
Never Worked in H.S.	.709***	(2.62)	1.040***	(3.20)	1.302***	(3.90)	.713*	(1.72)
Work Hours, Senior	- .002	(- .30)	- .003	(- .37)	- .009	(-1.47)	- .002	(- .31)
Work Hours, Summer	- .004	(- .60)	- .002	(- .37)	- .002	(- .47)	.008	(1.19)
Work Hours, Junior	- .003	(- .96)	- .003	(- .51)	.003	(.06)	- .002	(- .36)
Worked, Summer Only	- .034	(- .17)	.522**	(2.13)	.259	(1.33)	- .160	(- .59)
Test Score	- .006	(- .74)	- .009	(- .95)	- .012	(-1.33)	- .012	(-1.05)
Vocational Course	- .006	(- .23)	- .037	(- .84)	- .050	(-1.17)	.078	(1.61)
English, Mathematics	.046	(1.03)	.054	(1.13)	.050	(1.09)	.037	(.59)
Other Academic	- .065**	(-2.47)	- .019	(- .51)	.018	(.46)	- .030	(- .59)
Grade, Trade & Technical	- .075	(- .36)	.436*	(1.68)	.154	(.60)	- .497	(-1.54)
Grade, Business & Office	.231**	(2.14)	.165	(1.24)	.217*	(1.78)	.194	(1.20)
Grade Point Average	.009	(1.53)	.005	(.59)	.008	(.94)	.023**	(2.17)
Locus of Control	- .024	(- .30)	- .126	(-1.10)	- .107	(- .90)	.100	(.58)
Self Concept	- .076	(-1.30)	- .039	(- .48)	- .036	(- .40)	- .141	(-1.49)
Work Orientation	- .040	(- .65)	- .069	(- .94)	- .039	(- .55)	.141	(1.35)
Lambda	- .094	(- .10)	-2.578**	(-2.02)	-3.240**	(-2.46)	.398	(.25)

* significant at 10% level (two sided)
** significant at 5% level (two sided)
*** significant at 1% level (two sided test)
t values in parentheses

TABLE 4.9

TIME PROFILE OF WORK HOURS AND WAGE
MALE--RECURSIVE FORM ESTIMATES

Work Hours Tobit	Period 2		Period 3		Period 4	
Wage in High School	-1.017	(-1.26)	- .248	(- .42)	.802	(1.30)
Never Worked in H.S.	-10.482***	(-2.72)	.743	(.27)	3.032	(1.04)
Work Hours, Senior	.044	(.93)	.004	(.12)	.022	(.62)
Work Hours, Summer	.015	(.35)	.069**	(2.22)	.045	(1.40)
Work Hours, Junior	- .003	(- .07)	- .049	(-1.52)	.047	(1.42)
Worked, Summer Only	4.718***	(2.80)	-1.080	(- .87)	- .380	(- .29)
Test Score	.102	(1.29)	.091	(1.56)	.074	(1.23)
Vocational Course	.866***	(3.37)	.363*	(1.91)	.204	(1.04)
English, Mathematics	.370	(.91)	- .247	(- .82)	.106	(.34)
Other Academic	- .469	(-1.48)	- .183	(- .79)	.103	(.43)
Grade, Trade & Technical	- .753	(- .58)	- .653	(- .68)	-2.330**	(-2.35)
Grade, Business & Office	- .866	(- .44)	.630	(.44)	-1.554	(-1.04)
Grade Point Average	- .196**	(-2.37)	.000	(.01)	- .107*	(-1.70)
Locus of Control	.509	(.63)	1.382**	(2.33)	- .115	(- .19)
Self Concept	.480	(.63)	- .053	(- .10)	- .966*	(-1.68)
Work Orientation	-1.858**	(-2.25)	.282	(.46)	- .414	(- .66)
Work Hours, 1st Period	.676***	(22.83)	- .007	(- .26)	- .044	(-1.56)
Work Hours, 2nd Period	---		.882***	(29.96)	.087**	(2.01)
Work Hours, 3rd Period	---		---		.835***	(20.93)

Wage Rate Heckman's 2nd Step	Period 2		Period 3		Period 4	
Wage in High School	.449***	(4.79)	.410***	(4.00)	.387***	(3.20)
Never Worked in H.S.	1.182**	(2.21)	1.440***	(2.75)	1.897***	(3.16)
Work Hours, Senior	- .004	(- .77)	- .002	(- .26)	.001	(.19)
Work Hours, Summer	.006	(1.25)	.007	(1.30)	.009	(1.48)
Work Hours, Junior	.008	(1.54)	.007	(1.27)	.013**	(2.02)
Worked, Summer Only	- .078	(- .40)	.121	(.57)	.104	(.42)
Test Score	- .010	(-1.13)	- .008	(- .76)	- .007	(- .60)
Vocational Course	.007	(.24)	.012	(.39)	.027	(.72)
English, Mathematics	.028	(.61)	.053	(1.04)	.061	(1.02)
Other Academic	- .013	(- .35)	- .019	(- .47)	- .029	(- .63)
Grade, Trade & Technical	.336**	(2.30)	.515***	(3.21)	.551***	(2.89)
Grade, Business & Office	.333	(1.54)	.284	(1.21)	.562**	(2.00)
Grade Point Average	- .003	(- .31)	.001	(.10)	.002	(.18)
Locus of Control	.045	(.49)	.128	(1.25)	.176	(1.48)
Self Concept	- .204**	(-2.42)	- .233**	(-2.49)	- .179	(-1.61)
Work Orientation	- .061	(- .64)	.051	(.49)	.090	(.74)
Lambda	- .886	(- .98)	- .663	(- .93)	- .946	(-1.16)
Work Hours, 1st Period	- .007	(- .92)	.003	(.68)	.003	(.51)
Work Hours, 2nd Period	---		- .005	(- .64)	.006	(.63)
Work Hours, 3rd Period	---		---		- .019*	(-1.71)

* significant at 10% level (two sided)
** significant at 5% level (two sided)
*** significant at 1% level (two sided test)
t values in parentheses

TABLE 4.10

TIME PROFILE OF WORK HOURS AND WAGE
FEMALE--RECURSIVE FORM ESTIMATES

Work Hours Tobit	Period 2		Period 3		Period 4	
Wage in High School	.652	(.86)	- .238	(- .40)	.219	(.38)
Never Worked in H.S.	-3.135	(-1.09)	-3.790*	(-1.68)	.152	(.07)
Work Hours, Senior	.084	(1.46)	.026	(.58)	- .022	(- .50)
Work Hours, Summer	- .063	(-1.56)	.084***	(2.65)	.029	(.96)
Work Hours, Junior	.090*	(1.93)	- .059	(-1.59)	.031	(.88)
Worked, Summer Only	-2.455	(-1.48)	- .273	(- .21)	-1.821	(-1.44)
Test Score	.034	(.41)	.092	(1.42)	.094	(1.50)
Vocational Course	1.136***	(3.54)	.353	(1.38)	- .098	(- .40)
English, Mathematics	.283	(.61)	- .272	(- .75)	- .455	(-1.29)
Other Academic	- .444	(-1.32)	- .528**	(-1.98)	- .105	(- .41)
Grade, Trade & Technical	-1.336	(- .52)	-1.720	(- .85)	1.401	(.73)
Grade, Business & Office	.453	(.35)	- .735	(- .73)	.303	(.31)
Grade Point Average	- .014	(- .18)	.059	(.95)	.063	(1.04)
Locus of Control	2.048***	(2.59)	1.706***	(2.73)	1.605***	(2.65)
Self Concept	-1.120*	(-1.72)	- .721	(-1.40)	- .325	(- .66)
Work Orientation	.462	(.69)	.398	(.75)	1.196**	(2.34)
Work Hours, 1st Period	.722***	(22.29)	- .081***	(-2.62)	.010	(.33)
Work Hours, 2nd Period	---		.924***	(29.80)	.002	(.60)
Work Hours, 3rd Period	---		---		.945***	(26.19)

Wage Rate Heckman's 2nd Step	Period 2		Period 3		Period 4	
Wage in High School	.135*	(1.72)	.175**	(2.37)	.184*	(1.88)
Never Worked in H.S.	1.003***	(3.10)	.948***	(3.18)	.748*	(1.92)
Work Hours, Senior	.007	(1.20)	- .001	(- .17)	- .003	(- .45)
Work Hours, Summer	.006	(1.49)	.006*	(1.66)	.008	(1.56)
Work Hours, Junior	.000	(.01)	.000	(.04)	- .003	(- .44)
Worked, Summer Only	.232	(1.23)	.017	(.10)	- .119	(- .53)
Test Score	- .002	(- .21)	- .003	(- .37)	- .012	(-1.10)
Vocational Course	.007	(.20)	.015	(.47)	.067	(1.63)
English, Mathematics	.026	(.55)	.020	(.44)	.032	(.54)
Other Academic	- .039	(-1.12)	- .035	(-1.06)	- .027	(- .61)
Grade, Trade & Technical	.293	(1.16)	- .051	(- .21)	- .458	(1.45)
Grade, Business & Office	.237*	(1.85)	.239*	(1.96)	.178	(1.11)
Grade Point Average	.006	(.68)	.013	(1.57)	.024**	(2.34)
Locus of Control	.005	(.05)	.103	(1.29)	.091	(.87)
Self Concept	- .098	(-1.32)	- .121*	(-1.82)	- .126	(-1.47)
Work Orientation	- .017	(- .24)	.025	(.37)	.137	(1.56)
Lambda	- .892	(-1.42)	- .315	(- .68)	1.000*	(1.95)
Work Hours, 1st Period	- .017**	(-1.99)	- .004	(-1.18)	- .004	(- .82)
Work Hours, 2nd Period	---		.002	(.23)	.005	(.68)
Work Hours, 3rd Period	---		---		.015	(1.38)

* significant at 10% level (two sided)
** significant at 5% level (two sided)
*** significant at 1% level (two sided test)
t values in parentheses

form estimates and some of the point estimates are negative. The direct effect of basic skills on work hours is not highly significant but the point estimates are uniformly positive throughout the observation period and t values are mostly larger than one. So we can conclude that the effect of basic skills persists over the observation period and it continues to help youth employment.

Effect of Vocational Education and Grades

The estimates of the total effect of curriculum variables are obtained from the reduced form model coefficients. For both male and female, vocational education shows highly significant positive effects on work hours from the second period to the fourth period, while the effect in the first period is insignificant. This result does not suggest that vocational education is not effective in placing high school students right after graduation. As discussed earlier, a large portion of high school graduates do not start working before September, even when they are offered the position before graduation. Observed work hours in the summer do not fully reflect the effect of vocational education because a large portion of those who searched for the position tend to spend the first summer on vacation. This conjecture may be supported by the estimates in the recursive model. The estimates for the direct effect of vocational education in the second period are significantly positive for both male and female but are insignificant in the later periods. This implies that positive total effects of vocational education are mainly in placing students to steady jobs after graduation. In the later periods the positive effects are transmitted through higher work hours in the previous periods. On the other hand, the effects of vocational education are negligible in the male wage equation. The estimates in wage equations for both the reduced model and the recursive model are close to zero and only one coefficient for males in the first period is significantly different from zero.

The positive effect of vocational education on wage rates is found if students get good grades in vocational education. The estimates from reduced and recursive models show that good grades in vocational education raises wage rates of both male and female students. The difference between gender is found in relative advantage by subject. For males, good grades in both business and office and trade-technical courses raise the wage rates throughout the 21-month period. The point estimate of the effect of good grades is 45 cents to 55 cents per hour in the fourth period (16 to 21 months after high school) and effects seem to persist after the observational period. For females there is a difference in effects of good grades by the subject. The estimate of coefficients for grades in business and office courses are significantly positive in the first through third periods, but the estimate for grades in trade-technical courses are insignificant throughout the 21-month period.

These differential effects of grades may be the result of the difference in the types of jobs between males and females. Typical entry-level jobs for females with good vocational preparation in business and sales are clerical jobs such as secretary and service positions. In these jobs the level of skill when they are fully trained is not very high. Advantage by good preparation will disappear after the training period for untrained workers is over and the average training period may be less than 1 year. For male workers, the typical jobs for well-prepared high school graduates provide more training and the return from training is high, and so the training period is longer. We expect that the change in wage rate reflects the improvement in productivity. If that is the case, the long-lasting effect of good grades in vocational education for males is reflecting better job placement and improvement in productivity due to high school vocational training.

The difference in the effect of grades in vocational education for males and females may be explained by the difference in types of work between the sexes. In Bishop's (1982) study of worker employability, he reports that workers with better vocational preparation are more productive in the initial stage of employment, have higher return to the on-the-job training, and receive more training than less prepared workers. The typical jobs considered in the study are relatively low-skilled entry level-jobs and male high school graduates are one of the typical employees.

On the other hand, typical female jobs do not require high skill and long training periods. Unlike typical male jobs, better vocational preparation often means less training on the job, and in the long run wage rates difference caused by vocational training disappear. In order to elaborate the above argument, we present two models of the relationship between productivity (wage rate) and training and then examine the data on wage growth by classifying by the occupations.

Figures 1 and 2 illustrate the two distinct relationships between training and productivity. The first figure illustrates the case in which the ceiling in productivity exists.

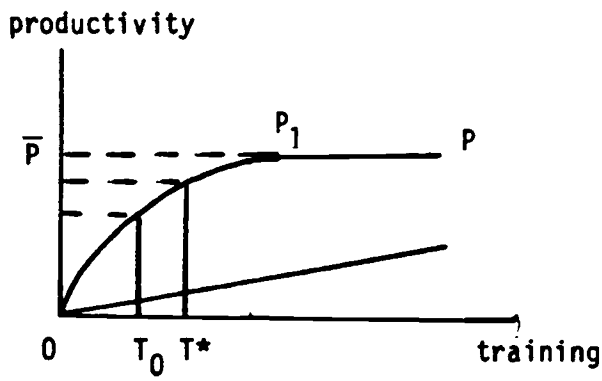

Figure 1.

In Figure 1 the curve $0 - p_1 - p$ is the productivity of the worker with no previous training, OC is the cost of training, and $O\overline{P}$ is the maximum productivity attainable in this job. From the firm's point of view, the optimal amount of training is OT* at which the return from training is maximized. If the new hire does not have previous work experience, the amount of training he/she will receive is OT*. If the new hire has previous vocational training, at amount OT_0, the amount of training offered by the firm is T_0T^*. If youths are assigned to this type of job their productivity will be equalized after the training period is over. The difference in productivity, and so in wage rate, will be observed in the initial stage of employment when there are variations in previous training. The difference, however, disappears after the training is completed. Thus this model predicts large variance in the starting wage compared to the wage in the later stage of employment.

Figure 2 illustrates the case in which the previous training increases both average and marginal return to the training.

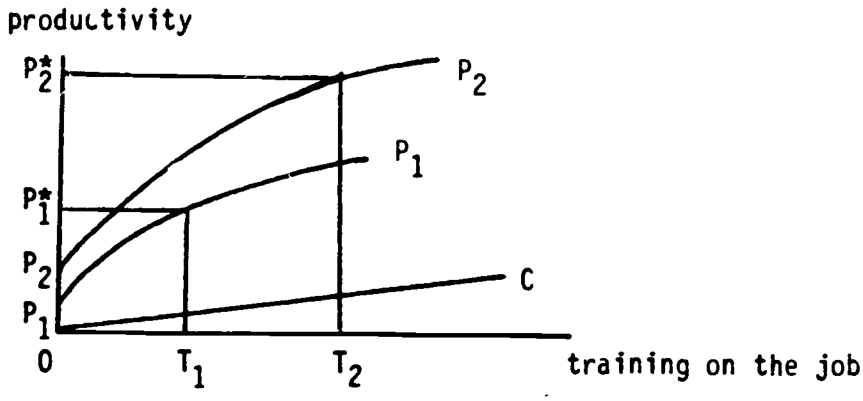

Figure 2.

In Figure 2 the curve P_1P_1 is the productivity of the worker with little previous training, the horizontal axis is the amount of training received on the job, and OC is the cost of training. The desirable level of training for less trained worker is OT_1, and their productivity will increase from OP_1 to OP_1^*. The productivity curve for well prepared workers is depicted by P_2-P_2. The optimal level of on-the-job training is OT_2 and their productivity increases from OP_2 to OP_2. Predictions from this model are as follows:

(1) Better prepared workers receive more training and their training period is longer.

(2) The better the worker is prepared for the job, the longer the period of wage increase.

(3) Variations in wage rate (productivity) increases over time.

Table 4.11 shows the relation between the first occupation, sex, starting wage, and average wage during the 21-month period. Although the average wage classified by the first occupation does not necessarily correspond to the average wage of particular occupation, it gives a reasonably close picture of wage growth by occupation. The typical occupation for female youth is clerical (includes secretaries, bank tellers, office machine operators, typists) and service (includes cleaning, food service, waitress). More than 70 percent of female first occupations are included in these two categories. Males typical first occupations are laborer, farm worker (24 percent), service (23 percent), operative (16 percent), and craftsman (13 percent). Table 4.11 shows that starting wage for males is uniformly higher than for females and change in wage rate (difference between starting and average wage) is larger for

TABLE 4.11

STARTING AND AVERAGE HOURLY WAGE BY FIRST OCCUPATION

First Occupation		Share	Wage Rates: Starting Wage Mean	Starting Wage S.D.	Average Wage Mean	Average Wage S.D.
1. Professional, Manager	M	5%	$3.46	(1.79)	$5.15	(3.02)
	F	[illegible]	$[illegible].14	[illegible]	$4.16	[illegible]
2. Sales	M	6%	$3.17	(1.50)	$4.39	(2.1[illegible])
	F	12%	$3.01	[illegible]	$[illegible].73	[illegible]
3. Clerical	M	16%	$3.50	(1.[illegible])	$4.62	(2.01)
	F	45%	[illegible]	(1.[illegible])	$4.13	(1.57)
4. Craftsman	M	14	$4.01	(1.53)	$5.16	(1.[illegible])
	F	2	$3.[illegible]	(2.0[illegible])	[illegible]	(3.1[illegible])
5. Operative	M	17%	$3.50	(1.95)	$4.93	(2.25)
	F	[illegible]	$3.49	(1.[illegible])	$3.59	[illegible]
6. Laborer, Farm	M	25%	$3.69	(2.03)	$4.64	(1.86)
	F	2	$2.92	(1.47)	$3.63	[illegible]
7. Service	M	24%	$3.26	(1.55)	$4.26	(1.67)
	F	[illegible]	$2.57	(1.[illegible]9)	$[illegible]	(1.[illegible]7)

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males. A more remarkable fact is that except for craftsman and professional the standard deviations--measure of wage dispersion within the same occupation--of average wage for females is smaller than those of the starting wage, while the standard deviations for males increase over the period.

These differences in observed wage rate growth between males and females support out hypothesis that females tend to get the job with fixed skill requirements (ceiling in productivity) and even within the same occupation group, males get the job with better promotion opportunities and higher wage increases.

The Effects of Work Experience

We shall look at the effect of work while in high school and the work experience after graduation. The variables representing the work experience in high school are the wage rate while in high school, dummy for those who did not work in high school, and average work hours in the junior year, in the summer between the junior and senior years, and in the senior year. In order to identify the effect of work in the summer, the dummy variable for those who worked only in the summer is included in the regression. Since it is difficult to summarize differences in the estimated coefficients for the above six variables over four periods, we shall compare the predicted wage rates and work hours for the three groups of students. They are, those who worked 20 hours per week in their junior through senior years, those who worked 20 hours per week only in the summer, and those who did not work at all. The predicted values are calculated from the point estimates from the reduced form models assuming all the background variables, except the variables relating to high school work experience, take sample mean values.

The table 4.12 shows the numerical values of the high school work experience variables used in the computation of predicted values. Table 4.13 shows the predicted effects of work experience in high school. Since the predicted wage and work hours show different patterns for males and for females, we discuss the results for males and females separately.

TABLE 4.12

VALUES USED IN THE PREDICTION ON
THE EFFECTS OF WORK IN HIGH SCHOOL

Wage rate in high school	Worked 20 hours from Jr. to Sr.	Worked 20 Hours Only in Summer	No Work in High School
Male	3.37*	3.37	0
Female	2.99**	2.99	0
Never Worked in High School	0	0	1
Worked Hours in Sr. Year	20	0	0
Worked Hours in Summer	20	20	0
Worked hours in Jr. Year	20	0	0
Worked Only in Summer	0	1	0

*, **3.37 and 2.99 are sample means of wage rate for male and female students who worked in high school.

For males, the differences in work hours and wage between those who worked through high school and those who worked only in the summer become very small after the second period. Between periods two through four, difference in weekly work hours is less than 2 hours and the gaps in wage rates are less than 30 cents per hour. The predicted differences in the initial period are rather large. Differences are 12 in work hours and 60 cents in wage rates. The differences in the initial period can be interpreted as the persistent nature of current work status rather than causal relation between work experience and labor market outcomes. There is a tendency that those who worked in one position tend to stay in the same position at the same work condition (work hours and wage rates) in the subsequent periods regardless of their employability or productivity. Similarly, those who do not hold the job at the time of graduation tend to stay in unemployment status for the next few months. Considering these inertia (persistence) effects of previous status, it is remarkable that the difference in predicted work hours and wage rate almost disappear after 3 months.

TABLE 4.13

EFFECT OF WORK IN HIGH SCHOOL

	Male							
	Predicted Work Hours				Predicted Wage Rate			
	Period 1	Period 2	Period 3	Period 4	Period 1	Period 2	Period 3	Period 4
Worked 20 hrs/week Jr, through Sr.	34.[illegible]	35.4	35.4	37.[illegible]	4.[illegible]	4.31	4.61	5.04
Worked 20 hrs/week in Summer Only	22.8	33.7	34.6	34.2	3.40	4.17	4.54	4.75
No Work in High School	13.2	16.7	23.9	24.5	3.02	2.96	3.34	4.50

	Female							
	Predicted Work Hours				Predicted Wage Rate			
	Period 1	Period 2	Period 3	Period 4	Period 1	Period 2	Period 3	Period 4
Worked 20 hrs/week Jr, through Sr.	34.[illegible]	34.8	34.4	34.[illegible]	3.53	3.64	3.[illegible]	4.39
Worked 20 hrs/week in Summer Only	21.6	22.0	26.[illegible]	25.9	3.61	4.22	4.25	4.30
No Work in High School	16.2	18.7	19.6	21.0	3.67	4.70	5.03	4.47

On the other hand, male students with no work experience in high school tend to work much less than the other two groups in the 21-month period. The difference is 10 and 20 hours in the first period and 10 to 13 hours in the fourth period. Wage rate, however, catches up more rapidly than work hours. The difference in the first period is $1.03 per hour (compared to those who worked in junior to senior years) but it is reduced to $.54 by the end of the fourth period.

For females we observe very different patterns of the effects of work experience in high school. Predicted values show no difference in wage rate in the first and the fourth period, and in the second and third periods the predicted wate rates for the more experienced students are less than the ones for those with less work experience. Since it is hard to imagine that, other things being equal, the work experience in high school lowers the productivity of youths, the perverse pattern of wage rates should be interpreted as work experience in high school does not affect female's wage rate.

Two explanations are possible to describe the insignificance of high school work experience on wage rate. The first is that majority of females work in the jobs that offer minimum wage regardless of previous work experience in high school. The second is that typical female jobs in high school are not directly related to the job after high school. The work experience in high school does not help raise the skill level in the job after high school.

The predicted work hours, however, show distinctive patterns corresponding to each of three high school work experiences. Those who worked 20 hours per week in their junior through senior year continue to work 34 hours per week through two years after graduation. Those who worked only in the summer work less than the first group and the difference does not disappear after 21 months. In the initial period, the difference is 12 hours and it is 8 hours in the fourth period. The difference between effects of summer work experience and no work experience is rather small. The difference is 5.4 hours in the initial period and 4.4 hours in the fourth period. These predicted work hours suggest that there is a distinctive gap between the two groups classified by work experience in the high school. Those who worked through high school years continue to hold steady jobs after graduation and those who did not work in the regular school period work much less than the first group.

Summary and Conclusions

In this study we analyzed the effects of the three aspec's of high school experience--work experience, amount of vocational and course work in basic academic fields, and the achievement level in basics--on youths' early labor market outcomes. The use of longitudinal data from the HSB survey enabled us to estimate the time profile of earnings, work hours, and wage rate as the functions of the three aspects of high school experience.

Analysis of the longitudinal data on earnings suggest that all three aspects of high school experience improve students' earnings after graduation but differences are found in the time patterns of the effects. We found the following:

- Work experience in high school is strongly associated with higher earnings right after graduation and the positive association persists over the 21-month period after graduation. However, its magnitude and importance diminish over time. Those who worked 20 hours per week through the last three years in high school earn 17 to 20 percent more than the students with no work experience in high school in the first 3 months after graduation. However, the relative advantage due to high school work experience declines to about 10 percent in terms of weekly earnings after 21 months from graduation.

- Vocational education has a positive effect on earnings. Amount of coursework in vocational education is positively associated with higher earnings in the beginning, and its positive effect continue to increase in the next 21 months. Two years of high school vocational education increases earnings by 5 percent in the first 3 months after graduation. The effects of vocational education persists and its relative importance increases over the next 18 months. Twenty-one months after graduation, increases in earnings is 7 percent for males, and more than 10 percent for females.

- Effect of basic skills (in mathematics and English) shows a similar time pattern as vocational education. Those with higher basic skills earn more than those with low skills from the very early stage in the labor market and the difference increases with time. One standard deviation increase in the test score predicts nearly 10 percent increase in earnings after 21 months from graduation. On the other hand, amount of coursework in basics does not show any significant effects on earnings. It implies that amount of coursework in basics, per se, is not important but the effectiveness of basic education is.

These findings are examined more closely by looking at the time profile of wage rate and work hours. Sequential analysis of work hours and wage rates revealed the following relations:

- There are distinctive differences in the effects of work experience between males and females. For males, the difference in work experience results in wage difference. In the first 3 months after graduation, those who worked through high school earn $1.00 per hour (33 percent) more than the students with no work experience. Although the wage gap diminishes gradually over the observation period, it does not disappear after 21 months. By the end of the 21-month period, the difference is reduced to about 50 cents per hour. Contrary to males, throughout the observation period no difference is found in females wage rate by work experience. The impact on work hours diminishes gradually for both males and females but the differences between gender are found in the impact of summer work. For males, after 3 months from graduation, there is little difference in work hours between those who worked through high school and those who worked only in the summer. On the other hand, for the females a major gap is found between those who worked through high school and those who did not work during regular school time. Differences in weekly work hours are 11 hours (34 hours to 22 hours) in the first three months and 8 hours (34 hours to 26 hours) after the 21 months from graduation.

- Coursework in vocational education has lasting positive effects on both wage rate and work hours of males, but its effect for females is mainly on work hours. During the 4th month to the 21st month after graduation, an additional 2 years of vocational courses increases men's weekly work hours by a significant 2 hours (6 percent) and the wage rate by 12 cents per hour. For females, the effect of vocational education is about the same as males in terms of its impact on weekly work hours but no positive association is found between wage rate and vocational coursework.

- In addition to the amount of coursework, good performance in vocational courses further raises wage rates for both males and females. Male students who specialize in trade-technical courses and received good grades enjoy higher pay per hour through the observation period. Males who received mostly A and B in trade and technical courses get paid about 45 cents per hour (10 percent) more than those who didn't. Females good performance in business and office courses results in higher wages in the beginning but its effect seems to fade 18-months after graduation.

- Students with higher skills in mathematics and English work longer per week and the magnitude of the effect is quite stable. For both males and females, one standard deviation (8 points) increase in the test score is associated with statistically significant 2-hour increase in weekly work hours throughout the observation period. However, no significant relation is found between basic skills and hourly earnings. It follows that positive association between basic skills and weekly earnings is the result of longer work hours.

In order to explain the above findings, two models describing the relationship between wage rates and job training are presented. In the first model there is a ceiling in productivity and the job training in high school is a substitute for on-the-job training. The model predicts that those who have had job training in high school receive higher wage in the beginning but the advantage disappears after the training period is over.

In the second model, job training in high school complements on-the-job training. It predicts long-lasting effects of high school job training on wage rates. Observed patterns of the effects of job training seem to indicate that females' labor market experiences are better explained by the first model and the second model is a better description of male labor market outcomes.

APPENDIX A

In estimating the wage rate and work hours equations, we face the problem of unobservable dependent variables and truncation. In our data about 10 percent of the male sample and about 17 percent of the female sample did not hold any job during the 21-month period. Their weekly work hours are therefore recorded as zero and wage rates are not observed. In estimating the wage equation, exclusion of samples with no wage data will cause serious bias. Also, truncation of work hours at zero introduces nonlinearity in the regression (conditional expectation) function. This type of truncation in the dependent variable is first considered by Tobin (1958). The functional form of the nonlinear regression function can be specified under the normality assumption and the maximum likelihood (TOBIT) estimator will give an efficient estimate for the hours equation.

In estimating the wage equation, Heckman (1979) considered a two equation model with selectivity. The first equation is for the selection variable that determines observability of the other dependent variable in the second equation. By assuming normality of the joint distribution of disturbance terms and nonzero correlation between them, Heckman proposed a convenient two-step method of obtaining consistent parameter estimates for the second equation.

We briefly describe Heckman's method in estimating wage and work hours equations in our model. Let the latent variable for work hours be H^*, wage rate be W, and observed work hours be H. We assume that the latent variable H^* and wage rate W is determined by the following relation:

(A.1) $H^* = X\beta + U_H^*$

(A.2) $W = X\alpha + U_W$

(A.3) $\begin{pmatrix} U_H^* \\ U_W \end{pmatrix} \sim N(0,\Sigma) \qquad \Sigma = \begin{pmatrix} \sigma_{HH} & \sigma_{HW} \\ \sigma_{WH} & \sigma_{WW} \end{pmatrix}$

X is the student's background variable, β and α are the parameters to be estimated, and U_H, U_W are disturbance terms.

We assume that the realized work hour (H) is positive and equal to the latent variable if H^* is positive, and h is zero if H^* is nonpositive.

(A.4) $H = H^* = X\beta + U^*$ if $H^* > 0$

$H = 0$ if $H^* \leq 0$.

The wage rate is observed only when H^* is positive.

Under the normality assumption the conditional expectation of the observed wage is written as follows:

(A.5) $E(W|X,\, H^* > 0;\, \Sigma,\alpha) = X\alpha + C \cdot L(\tau)$

where $C = \sigma_{HW}/\sigma_{WW}$

$L(\tau) = f(\tau)/(1-F(\tau))$

$\tau = X\beta/\sqrt{\sigma_{HH}}$

f and F are the p.d.f. and the c.d.f. of the standard normal variable.

In the first step equation, (A 4) can be estimated by the maximum likelihood TOBIT and also the efficient estimates for β and σ_{HH} will be obtained.

In the next step, (A.5) is estimated by using the predicted values of L which are constructed from the estimates of β and σ_{HH}. The observed wage is regressed to the explanatory variables X and predicted values of L. The OLS estimate of α and C are consistent and so with a large number of observations we will have a consistent estimate of the parameters of wage equations defined in (A.1) and (A.2).

The reader should be cautious about the interpretation of estimated coefficients. The estimated coefficients for β and α are not consistent estimates of the expected marginal changes in <u>observed</u> values of work hours and wage rate due to change in the explanatory variables. Let us consider the case in which X consists of only one variable and so β and α are scalers.

The partial derivatives of the expected <u>observed</u> work hours with respect to X is given by the next equation.

$$\frac{\partial E(H)}{\partial X} = \frac{\partial}{\partial X}\left(Pr(H^* > 0)H^*\right)$$

$$= \partial pr(H^* > 0)/\partial X \cdot H^* + Pr(H^* > 0) \cdot \beta \neq \beta$$

The partial derivative of the expected work hour with respect to X is not β and it varies with level of X.

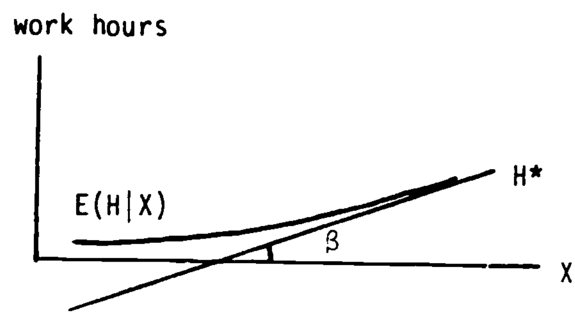

Figure A.1

The typical relation between the latent variable, H^*, the expected realized work hours, $E(H|X)$, and the background variable X is depicted in Figure A.1. The linear function H^* gives a good approximation to the expected value of work hours for a higher value of X but approximation is poor at a small value of X.

Similarly, the marginal change in observed wage with respect to X depends on the value of X. The partial derivative of the expected observed wage is given by the following:

$$\frac{\partial E}{\partial X}(W|X, H^* > 0, \Sigma, \alpha) = \alpha + c \,.\, \partial L/\partial X.$$

The numerical value of the above expression depends on α, Σ, and X, as well as the parameters of the bivariate normal distribution.

APPENDIX B

CREATION OF WAGE RATE, WEEKLY WORK HOURS AND EARNINGS DATA

The duration data on wage rate, weekly work hours, and weekly earnings are created from the responses to the questions shown in the next two wages. In the second wave of the survey the respondents reported the details of up to five jobs they experienced after high school graduation. For each job held, questions are asked about the starting month and year, the starting hourly wage, the average work hours, the ending or current hourly wage, and the ending or current month and year.

The data in the four periods--June 80 to August 80, September 80 to February 81, March 81 to August 81, and September 81 to February, 82--are created under the following two assumptions:

(A) Weekly work hours are constant in each job spell.

(B) Wage rate increases linearly with time. For each job, monthly earnings are computed from the interporated hourly wage and average weekly work hours. The resulting up to five monthly earnings and work-hours histories are then aggregated within the period. Average wage rates are defined as the total earnings in the period divided by the total work hours.

Weekly work hours are defined as the total work hours divided by the number of weeks in the period. Similarly, weekly earnings are obtained from the division of total earnings in the period by the number of weeks in the period.

	... JOB AFTER HIGH SCHOOL	2ND JOB AFTER HIGH SCHOOL
What kind of job or occupation did or do you have? (For example, salesperson, waitress, secretary, etc.) (WRITE IN)—	Office Use Only	Office Use Only
What kind of business or industry was this job in? (For example, retail shoe store, restaurant, etc.) (WRITE IN)—	Office Use Only	Office Use Only
What were your main activities or duties on this job? (For example, selling shoes, waiting on tables, etc.) (WRITE IN)—		
In this job were you ... (MARK APPROPRIATE CATEGORY)	An employee of a PRIVATE COMPANY ○ A GOVERNMENT employee (federal, state, local) ○ Self-employed in your OWN business ○ Working WITHOUT PAY in family business or farm ○	An employee of a PRIVATE COMPANY ○ A GOVERNMENT employee (federal, state, local) ○ Self-employed in your OWN business ○ Working WITHOUT PAY in family business or farm ○
When did you start working at this job? (MARK OVALS FOR MONTH and YEAR)	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1976 or before ○1977 ○1978 ○1979 ○1980 ○1981 ○1982	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1980 ○1981 ○1982
When did you leave this job? (MARK OVALS FOR MONTH and YEAR.) (IF YOU STILL HAVE THIS JOB, MARK THIS OVAL.)—	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1980 ○1981 ○1982 Still have this job.. ○	Month: ○Jan. ○Feb. ○March ○April ○May ○June ○July ○Aug. ○Sept. ○Oct. ○Nov. ○Dec. Year: ○1980 ○1981 ○1982 Still have this job ○
What was your starting salary on this job? (WRITE IN)	$______ (MARK ONE) ○ hourly ○ weekly Office Use Only	$______ (MARK ONE) ○ hourly ○ weekly Office Use Only

:ASE READ INSTRUCTIONS— GO TO COLUMN A, PAGE 10. GO TO COLUMN B, PAGE 10.

. Continued.

	1ST JOB AFTER HIGH SCHOOL	2ND JOB AFTER HIGH SCHOOL
What is your salary on this job or what was it at the time that you left? (WRITE IN)	(MARK ONE) hourly $________ weekly Office Use Only	(MARK ONE) hourly $________ weekly Office Use Only
About how many hours a week did or do you usually work in this job? (WRITE IN)	________ hours per week Office Use Only	________ hours per week Office Use Only
) How did you find this job? (MARK MOST IMPORTANT CATEGORY)	School employment or placement service Public employment service Private employment agency Newspaper advertisement Checked with employer directly Through a relative Through a friend Civil Service application Other (WRITE IN) ________	School employment or placement service Public employment service Private employment agency Newspaper advertisement Checked with employer directly Through a relative Through a friend Civil Service application Other (WRITE IN) ________
1) Why did you leave this job? (MARK APPROPRIATE CATEGORY)	Lost job (fired, laid off, job ended) Left job to return to school Quit because job, hours, or pay, etc. unsatisfactory Still have this job Other (WRITE IN) ________	Lost job (fired, laid off, job ended) Left job to return to school Quit because job, hours, or pay, etc. unsatisfactory Still have this job Other (WRITE IN) ________
2) Were you without a job AND *looking for work* right after you left this job? (MARK APPROPRIATE CATEGORY) (IF YOU STILL HAVE THIS JOB, MARK THIS OVAL.)—	Yes (FOR HOW MANY WEEKS?—WRITE IN) ________ weeks No Still have this job Office Use Only	Yes (FOR HOW MANY WEEKS?—WRITE IN) ________ weeks No Still have this job Office Use Only
PLEASE READ INSTRUCTIONS—	TURN BACK TO PAGE 8 AND CONTINUE WITH YOUR SECOND JOB. IF YOU HAD NO OTHER JOB, GO TO Q. 25 ON PAGE 12.	TURN BACK TO PAGE 9 AND CONTINUE WITH YOUR THIRD JOB. IF YOU HAD NO OTHER JOB, GO TO Q. 25 ON PAGE 12.

REFERENCES

Alexander, Karl L.; McPartland, James M.; and Cook, Marth 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.

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.

Becker, Gary S. Human Capital. New York: Columbia University Press, 1975.

Bishop, J. "The Social Payoff from Occupationally Specific Training: The Employer's Point of View." Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, November, 1982.

Bluestone, Barry. "The Tripartite Economy: Labor Markets and the Working Poor." Poverty and Human Resources 5 (1970):15-35.

Boyer, Ernest L. High School: A Report on Secondary Education in America. New York: Harper & Row, Publishers, 1982.

Cain, Glenn G. "The Challenge of Segmented Labor Market Theories to Orthodox Theory: A Survey." Journal of Economic Literature 14 (1976):1215-1257.

Campbell, Paul B., Gardner, John A., an Seitz, Patricia. "Post Secondary Experience of Students with Varying Participation in Secondary Vocational Education." Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, 1982.

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 Mathematical Study of Change." In Methodology in Social Research, edited by Herbert M. Blalock and Ann B. Blalock. New York: McGraw-Hill, 1968.

Coleman, James S.; Hoffer, Thomas; and Kilgore, Sally. High School Achievement. New York: Basic Books, 1982.

Doeringer, Peter B., and Piore, Michael J. Internal Labor Markets and Manpower Analysis. Lexington, MA: Lexington, 1971.

Doreian, Patrick, and Hummon, Norman P. Modeling Social Process. New York: Elsevier, 1976.

Ellwood, David T. "Teenage Unemployment: Permanent Scars or Temporary Blemishes." The Youth Labor Market Problem: Its Nature, Causes and Consequences, edited by Richard B. Freeman and David A. Wise, pp. 349-385. Chicago: University of Chicago Press, 1981.

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.

Gardner, John A. "Influence of High School Curriculum on Determinants of Labor Market Experience." Columbus, OH: The National Center for Research in Vocational Education, The Ohio State University, April 1984.

Goodlad, John L. A Place Called School: Prospects for the Future. New York: McGraw-Hill, 1983.

Grasso, John T. and Shea, John R. Vocational Education and Training: Impact on Youth. Berkeley, CA: Carnegie Counsil on Policy Studies in Higher Education, 1979.

Green, W.H. "LIMDEP: A Program for Estimating the Parameters of Qualitative and Limited Dependent Variables Models." The Americal Statistician 37, no. 2 (1983):170.

Green, W.H. "Sample Selection Bias as a Specification Error:Comment." Econometrica 49, no. 3 (1981):795-798.

Greenberger, Ellen, and Steinberg, Laurence D. "Part-Time Employment of In-School Youth: An Assessment of Costs and Benefits." Final report. Irvine: University of California, 1981.

Gustman, Alan L. and Steinmeier, Thomas L. "The Relationship Between Vocational Training in High School and Economic Outcomes." Cambridge, MA: National Bureau of Economic Research, July 1981.

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.

Heckman, James. "The Common Structure of Statistical Models of Truncation, Sample Estimation for Such Models." Annals of Economic and Social Measurement 5 (1976):475-492.

__________. "Sample Selection Bias as a Specification Error." Econometric 47, no. 1 (1979):153-162

Hertel, Bradley R. "Minimizing Error Variance Introduced by Missing Data Routines in Survey Analysis." Sociological Methods and Research 4 (1970):459-474.

Heyns, Barbara. Summer Learning and the Effects of Schooling. New York: Academic Press, 1978.

Hodson, Randy, and Kaufman, Robert L. "Economic Dualism: A Critical Review." American Sociological Review 47, no. 6 (1982):727-739.

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.

________________. Effects of Schooling on Cognitive, Attitudinal, and Behavioral Outcomes. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

________________. Effects of Work Time on School Activities and Career Expectations. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1982.

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.

Jones, Calvin; Clarke, Miriam; Mooney, Geraldine; McWilliams, Harold; Crawford, Ioanna; Stephenson, Bruce; and Touranqeau, 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, S. and Bishop, J. "The Effects of Curriculum on Labor Market Success Immediately After High School." Columbus, OH: 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.

Keeley, Michael C. Labor Supply and Public Policy: A Critical Review. New York: Academic Press, 1981.

Kerr, Clark. "The Balkanization of Labor Markets." In Labor Mobility and Economic Opportunity, edited by Paul Webbink. New York: Wiley, 1954.

Kim, Jae-On, and Curry, James. "The Treatment of Missing Data in Multivariate Analysis." Sociological Methods & Research 6, no. 2 (November 1977): 215-240.

Lewis, Morgan V.; Gardner, John A.; and Seitz, Particia. High School Work Experience and Its Effects. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1983.

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, 1975.

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.

Mertens, Donna M., and Garnder, John A. Vocational Education and the Younger Adult Worker. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1981.

Meyer, Robert H. An Economic Analysis of High School Vocational Education: IV The Labor Market Effects of Vocational Education. Washington, DC: The Urban Institute, August 1981.

Meyer, Robert H., and Wise, David A. "High School Preparation and Early Labor Force Experience." In The Youth Labor Market Problem: Its Nature, Causes, and Consequences, edited by R. B. Freeman and D. A. Wise, pp. 277-339. Chicago: University of Chicago Press, 1982.

————————. High School Preparation and Early Labor Market Experience. Discussion Paper Series. Cambridge, MA: John Fitzgerald Kennedy School of Government, Harvard University, 1980.

Mincer, Jacob. Schooling, Experience, and Earnings. New York: National Bureau of Economic Research, 1974.

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.

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.

National Commission on Secondary Vocational Education. The Unfinished Agenda: The Role of Vocational Education in the High School. Columbus: The National Center for Research in Vocational Education, The Ohio State University, 1984.

National Opinion Research Center. High School and Beyond 1980 Senior Cohort First Follow-up (1980) Data File User's Manual. Chicago: University of Chicago, April 1983.

Rumberger, Russell W., and Daymont, Thomas N. "The Economic Value of Academic and Vocational Training Acquired in High School." Paper presented at the annual meeting of the American Educational Research Association, New York: March 1982.

Rutter, Michael; Maughan, Barbara; Mortimore, Peter; Ouston, Janet; with Smith, Alan. Fifteen Thousand Hours. Cambridge, MA: Harvard University Press, 1979.

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.

Sørensen, Aage B., and Hallinan, Maureen T. "A Reconceptualization of School Effects." Sociology of Education 50 (October 1977):273-289.

Steinberg, L.; Greenberger, E.; Garduque, L.; Ruggiero, Mary; and Vaux, Alan. "The Effects of Early Work Experience on Adolescent Development." Developmental Psychology 18 (1982):385-395.

Stephenson, Stanley P. "In-School Labor Force Status and Post-High School Wage Rates of Young Men. Applied Economics 13, 1981.

Thurow, Lester C. Generating Inequality: Mechanisms of Distribution in the U.S. Economy. New York: Basic Books, 1975.

________________. "Vocational Education as a Strategy for Eliminating Poverty." In The Planning Papers for the Vocational Study, edited by Henry David. Washington, D.C.: The National Institute of Education, U.S. Department of Health, Education, and Welfare, 1979.

Tobin, J. "Estimation of Relationships for Limited Dependent Variables." Econometrica 26, no. 1 (1958):24-36.

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.

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.