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ABSTRACT

Data from the 1970 National Longitudinal Survey of Labor Market Experience are employed to estimate the foregone earnings of college students. An estimation of earnings functions from male and female youths who are not enrolled in school, and the potential earnings of enrollees is derived by substituting the characteristics of enrollees into the earnings functions of the nonstudents. Actual earnings are subtracted from potential earnings to derive estimates of foregone earnings. The estimation procedure provides a range of estimates by employing alternative earnings functions and assumptions concerning potential hours per year. Self-selection bias, part-time versus full-time employment, and levels of enrollments are also considered. Results are compared to other studies, and a projection of earnings foregone is made for 1975 and 1980. The estimation methodology is described and illustrated with numerous equations. The results suggest that earnings foregone per student vary greatly between males and females, part-time and full-time students, and between levels of enrollments. It is estimated that earnings foregone by college students in 1980 range from $42.69 billion to $73.37 billion. (SW)

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FOREGONE EARNINGS OF COLLEGE STUDENTS: A MICROANALYTIC APPROACH

by

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FOREGONE EARNINGS OF COLLEGE STUDENTS: A MICROANALYTIC APPROACH

ABSTRACT

Data from the 1970 wave of the National Longitudinal Survey of Labor Market Experience are employed to estimate the foregone earnings of college students. The basic methodology involves the estimation of earnings functions from male and female youths who are not enrolled in school, and the potential earnings of enrollees is derived by substituting the characteristics of enrollees into the earnings functions of the nonstudents. Actual earnings are substracted from potential earnings to derive estimates of foregone earnings. The estimation procedure provides a range of estimates by employing alternative earnings functions and assumptions concerning potential hours per year. Self-selection bias, part-time vs. full-time enrollment, and levels of enrollments are also considered. Our results are then compared to other studies, and a projection of earnings foregone is made for 1975 and 1980.

INTRODUCTION

There are four primary reasons for scholars to be interested in the estimation of foregone earnings of students. (1) There is an interest in the total costs of education, which includes not only explicit by also implict costs, the largest fraction of which is earnings foregone (Schultz, 1960; Blitz, 1962; Machlup, 1963; Cohn, 1977 and 1979, Chapter 4; Solmon, 1971; Kagann, 1975; Crary and Leslie 1978). (2) Closely related to (1), a proper estimation of national income (or gross national product) requires inclusion of both market and nonmarket activities, both implicit and explicit income and product flows. The estimation of foregone earnings of students is one of the implicit investment categories which must be estimated (Kendrick, 1972, 1974; Eisner, 1978, 1980; Eisner and Nebhut, 1981). (3) Estimation of rates of return to schooling requires the calculation of both direct and indirect costs of eduation, including foregone earnings (Hansen, 1963; Hanoch, 1967; and numerous other studies as cited in Cohn 1979, pp. 133-136). (4) Estimation of the demand for (especially higher) education by students or their families is normally assumed to require the use of foregone earnings as an explantory variable in the demand regression (Fuller, Manski and Wise, 1982; see also the surveys by Jackson and Weathersby, 1975, and Cohn and Morgan, 1978).

The purpose of this paper is to provide a new estimation method for the calculation of earnings foregone, especially for the first three purposes outlined above. The method is also relevant for the fourth purpose, but a similar method has already been employed by Fuller, Manski, and Wise (1982), so that we cannot claim orginality in that area of inquiry.

The basic methodology employed here (elaborated in the next section) is to estimate a student's foregone earnings on the basis of the earnings of a nonstudent, whose characteristics (e.g., age, sex, race, schooling, and IQ) are as similar as possible to the student under examination. Once the earnings foregone per student are calculated for all students, the sum of all earnings foregone may be calculated for the purpose of measuring the total costs of education in any given year. Since the universe of all students cannot be used to obtain the earnings foregone for each student, a sample of students (and nonstudents) must be used instead, and the total earnings foregone calculated on the assumption that the sample is representative of the total population. For that reason, a sample of a national scope is desired, and we have chosen the National Longitudinal Survey of Labor Market Experience (also known as the NLS, or the Parnes data) for purposes of estimation.

The methodology is explored in the first section, followed by presentation of the data and results in the second section. The third section offers a comparison of our results with those of other scholars, and the final section includes some concluding comments.

THE MODEL

Foregone earnings are defined as the difference between a student's potential earnings and his or her actual earnings. As pointed out by Becker (1964),

> In principle, the potential earnings of first-year college students should be measured by the actual earnings of otherwise equivalent persons who entered the full-time labor force after completing high school, the potential earnings of second-year students by the actual earnings of otherwise equivalent persons who entered the labor force after completing one year of college, and so on (p. 75).

Consider a sample with n students and m nonstudents. For each of the n + m observations we have information about individual characteristics, including age, sex, race, residence, years of school completed, parental socio-economic standing, and other relevant data. Denote the vectors of student and nonstudent characteristics by X^{s} and X^{ns}, respectively. If hourly earnings of nonstudents are denoted by E_{ns}, then we can specify an earnings function for nonstudents as in equation (1).

$$E_{ns} = f\,(X_{ns}) \qquad (1)$$

Using ordinary least squares, an empirical counterpart of Equation (1) could be estimated. The two most common specifications for Equation (1) are linear and semi-logarithmic forms, as in Equation (2) and (3):

$$E_{nsi} = \alpha + \sum_{k=1}^{K} \beta_k x_{ki} + \varepsilon_i \qquad i = 1, \ldots, n \qquad (2)$$

$$\log E_{nsi} = \gamma + \sum_{k=1}^{K} \delta_k x_{ki} + \nu_i \qquad i = 1,\ldots,n \qquad (3)$$

where α and γ are intercept terms, β_k and δ_k are the regression coefficients, x_{ki} are values of the the K explanatory variables for the ith individual, E_{nsi} is the hourly earnings of the ith nonstudent, and ε_i and ν_i are the respective error terms.

Using ordinary least squares (OLS) we can estimate the parameters of Equations (2) and (3). Thus $\hat{\alpha}$ is the OLS estimate of α, $\hat{\beta}$ is the OLS estimate of β, and so on.

In order that we follow the procedure proposed by Becker, it is necessary to match each student with an otherwise equivalent non-student. This is accomplished in our model by substituting the characteristics of each student in Equations (2) or (3), obtaining the hourly earnings that a student is predicted to earn if he or she were to be in the labor force rather than to go to school. If a student's potential hourly earnings and log of hourly earnings are denoted by $P(E_s)$ and $P(\log E_s)$, repsectively, then we have the following:

$$P(E_s)_j = \hat{\alpha} + \sum_{k=1}^{K} \hat{\beta}_k x_{kj} \qquad j = 1,\ldots,m \qquad (4)$$

or

$$P(\log E_s)_j = \hat{\gamma} + \sum_{k=1}^{K} \hat{\delta}_k x_{kj} \qquad j = 1,\ldots,m \qquad (5)$$

where x_{kj} are the values of the K explanatory variables for the jth student.

To convert potential hourly earnings into potential annual earnings we must multiply $P(E_s)$ and antilog[$PlogE_s$)] by annual hours worked per year, denoted by H. Therefore,

$$\text{Annual potential earnings} = P(E_s) \times H \quad (6)$$

or

$$\text{Annual potential earnings} = \text{antilog}\ [P(\log E_s)] \times H \quad (7)$$

Full-Time vs. Part-Time Students

Since full-time students as a group are likely to differ significantly from part-time students, potential earnings should be derived separately for each group. The process begins with estimation of Equation (2) and (3) using nonstudent data, and then repeating Equations (4) through (7) for full-time and part-time students.

Males vs. Females

Our data are given separately for males and females. Although it would have been possible to merge the two data sets, there is evidence in the literature that the structure of earnings functions might differ significantly between males and females. It seems plausible to argue that male-female differences in earnings structure are even more likely to exist for college-age youths. Potential earnings are estimated, therefore, separately for males and females.

Estimation of Foregone Earnings

Earnings Foregone per Student:

Estimates of earnings foregone are derived, for males and females, full-time and part-time students, by deducting actual earnings of students from potential earnings. Although a similar methodology has been employed by oth · ·udies, a novel aspect of this stage of the approach is the use of grade-specific annual earnings (from wages and salaries) for full-time and part-time students, respectively. Equations (8) and (9) summarize the calculation of foregone earnings per student (EF/P):

$$EF/P = [P(E_s) \times H] - Y_s \qquad (8)$$

or

$$EF/P = \{\text{Antilog } [P(\log E_s)] \times H\} - Y_s \qquad (9)$$

where EF/P is the earnings foregone per student and Y_s is the student's annual earnings from wages and salaries. EF/P is calculated separately by sex, full-time and part-time attendance, and grade-level in school.

Total Earnings Foregone: Total earnings foregone (EF) are calculated by multiplying the EF/P for each class of students (male, female, part-time, full-time, by grade) by the number of students in the group. For instance, if N_1 is the number of full-time lower-division undergraudate males, then:

EF (males, full-time, lower-division undergraduates)

$$= EF/P \times N_1$$

In general, total earnings foregone are computed according to the following formula:

$$\text{Total EF} = \sum_{i=1}^{I} (EF/P)_i \times N_i \qquad (10)$$

For the purposes of this study we identify twelve different groups of students (i.e., I = 12)

<u>Calculation of Hours of Work Foregone</u>. There is a controversy in the literature regarding the proper identification of hours lost from work due to education. We could use as a proxy the actual hours worked by nonstudents, properly adjusted for different student characteristics. It has been argued by Morgan and David (1963) and others that the actual hours worked by nonstudents may not be a satisfactory measure, because it includes the effect of work-leisure choices as well as unemployment. An alternative measure of hours of work is 2,000 hours per year, assuming the student <u>could</u> have worked 40 hours per week for 50 weeks.

<u>Alternative 1</u>. Our data sets do not have a variable for hours worked per year.[1] An estimate of the hours worked per year is given by the ratio of reported annual earnings to the hourly wage (i.e., $H_{ns} = Y_{ns}/E_{ns}$). That is, instead of estimating $P(E_s)$ and H separately, we can estimate $P(E_s)$ x H directly from a regression on annual earnings from wages and salaries (Y). That is,

$$P(E_s \times H) = P(Y_s) = a + \sum_{k=1}^{K} b_k x_{kj} \qquad j = 1,\ldots m \qquad (1)$$

where a and b_k are derived from a regression of Y_{ns} on the vector of income determinants, similar to the procedure indicated above for estimating $P(E_s)$. Again, both linear and log-linear functions of annual earnings are estimated.

[1]There is a variable for "normal hours worked per week," and "weeks worked between 1969 and 1970." The weeks variables, however, has a range of 0-68, implying that it does not measure the number of weeks <u>per year</u>.

Alternative 2. An alternative method is to assume that H = 2,000 hours, as indicated above, instead of predicted hours of work. In this case, we substitute 2,000 for H in equations (6) through (9). Since the average hours of work per year in our nonstudent sample is less than 2,000 hours per year, Alternative 2 will provide a higher estimate of earnings foregone than Alternative 1. By providing information about both alternatives, the reader can observe the range of estimates and select the estimate he or she believes to be the best[2].

Self-Selection Bias[3]

It has been recognized for some time that ordinary least squares (OLS) estimates from cross-secitonal data may be biased due to self-selection (and other econometric problems). The self-selection problem in our case is that $E(E_{nsi} | J = 0)$ might be different from $E(E_{nsi} | J = 1)$, where J = 1 indicates that the individual chose to pursue a given level of college education and J = 0 indicates that the individual chose otherwise. A number of methods have been proposed to correct for such a bias, but a recent study indicates that use of state-of-the art techniques has been far less than satisfactory. In their study of the effect of union membership on wages, Freeman

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[2]The average estimated hours per person in our NLS samples are 1,871 for nonstudent males and 1,366 for nonstudent females. Part-time students work more -- 1,896 and 1,409, respectively, for males and females -- and full-time students work much less -- 797 for males and 561 for females.

[3]I am grateful to Robert P. Trost for his help on this section. The usual caveats apply.

and Medoff (1981) provide the following comments:

> ... Studies which use systems of equations with cross-sectional data to "correct for" potential simultaneous equations and sample selection bias provide very little insight into whether the ... union/nonunion differences are real or illusory. The models employed rely on "restrictions" or "exclusions" which are far from convincing. Moreover, the results show great instability in the face of seemingly small changes in the model or the sample analyzed. In some cases these techniques yield union effects much below those obtained with OLS; in others they yield effects much above those from OLS; in yet others the systems of equations give about the same results as does OLS. In a surprisingly large number of cases, these techniques yield results so implausible on a priori grounds as to be dismissed out of hand. While this instability and implausibility does not demonstrate that the OLS union/nonunion differences are unbiased, it does indicate that the system of equations methodology does not offer a reliable and useful way of improving on these estimates (pp. 73-74).

Nevertheless, it might be instructive to follow at least one procedure by which the self-selection bias might be corrected, and examine the rough orders of magnitude involved. We use, for that purpose, a recent article by Trost (1981), which employs data similar to ours.

We must first estimate a college-choice equation, employing the technique of probit regression. Let X_i denote the vector of relevant explanatory variables, and γ the vector or estimated probit parameters. Then, we estimate the following wage equations:

$$W_{1i} = X_{1i}\beta_1 - \sigma_{1\varepsilon} \frac{f(X_i\hat{\gamma})}{F(X_i\hat{\gamma})} \qquad (12)$$

$$W_{2i} = X_{2i}\beta_2 + \sigma_{2\varepsilon} \frac{f(X_i\hat{\gamma})}{1-F(X_i\hat{\gamma})} \qquad (13)$$

where $f(\cdot)$ and $F(\cdot)$ are the standard normal density and cumulative functions, respectively ($F(\cdot)$ is the probability that individual i chooses college attendance), and β_1 and β_2 are the respective vectors of parameter for the two earnings functions. The covariances $\sigma_{1\varepsilon}$ and $\sigma_{2\varepsilon}$ can then be estimated by using OLS on (12) and (13).

Of interest in this paper is $E(W_{2i} | J = 1)$. That is, we want to answer the question: "What would the wage rate of college students be if they had not chosen college?" To get some rough ideas about the difference between the OLS estimates and estimates employing the Trost procedure we use the estimates obtained by Trost for $\sigma_{2\varepsilon} = 0.1868$, and $f(\cdot) = .3989$. If we assume that $F(\cdot)$ is approximately 0.5., then:

$$E(W_{2i} | J=1) = X_{2i}\beta_2 - (.1868)(.8) \tag{14}$$

$$= X_{2i}\beta_2 - 0.16$$

What these results indicate is that estimates of potential hourly wages based upon Equation (2) might be biased upwards by approximately 16 cents.

The empirical analysis presented in the following pages does not take into account the correction for self-selection bias. The interested reader can, however, make an appropriate adjustment to reflect the results shown here.[4]

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[4]The Trost results are based on the 1973 Parnes (NLS) data for male youths. Since wages were slightly higher in 1973 than in 1970, the adjustment to our data might be less than $0.16. Also, the adjustment for females and part-time students should be considerably lower.

DATA AND RESULTS

Data

The data set utilized in this study is the National Longitudinal Survey of Labor Market Experience (hereafter NLS). The data set employed here contains information on young males (age 16-28 in 1970) and young females (age 14-24 in 1968). Although NLS data are availabe for the male and female youths for the years 1966 - 1980, we have confined our analysis to 1970 to facilitate comparison with other studies and to keep the study within manageable bounds.

Some descriptive statistics concerning the variables chosen for the study from the NLS data are reported in Tables 1 and 2 (for males and females, respectively). The tables offer a contrast between students and nonstudents, and between full-time and part-time students. Especially noteworthy are the following observations:

1. Part-time students have higher wages and annual incomes than both nonstudents and full-time students, whereas full-time students earn far less per hour and annually than nonstudents.

2. Students appear to come from significantly higher SES families than nonstudents, but there is little difference in SES between part-time and full-time students.

3. Students have significantly higher IQs than nonstudents.

4. Full-time students are less likely to be married, to have dependents, and (for males) to have served in the armed forces than either part-time students or nonstudents.

5. The major difference between males and females is in hourly wages and annual income. Females earn less per hour and much less per year. Females work fewer hours per year, indicating a preference for non-market activities far greater than shown by males. Since the data are for 1970, generalizations to the present may not be warranted.

Table 1. Means and Standard Deviations of Variables for Males (1970).

Variable[a]	Non-Students N	Non-Students Mean	Non-Students Standard Deviation	Part-Time N	Part-Time Mean	Part-Time Standard Deviation	Full-Time N	Full-Time Mean	Full-Time Standard Deviation
HWAGE	2,598	3.22	1.52	160	3.67	1.55	634	2.37	1.31
LNHWAGE	2,598	1.39	0.33	160	1.49	0.32	634	1.16	0.31
YRINC	1,870	6,090.57	4,237.24	131	6,641.07	3,699.66	579	1,955.68	2,022.36
LNYRINC	1,870	8.13	1.94	131	8.31	1.76	579	6.65	2.24
AGE	2,968	22.90	3.21	172	23.13	3.24	841	19.99	2.19
AGESQ	2,968	534.30	148.26	172	545.33	149.68	841	404.30	94.52
RACE	2,968	0.71	0.45	172	0.84	0.37	841	0.79	0.41
NATLTY	2,968	0.77	0.42	172	0.57	0.50	841	0.68	0.49
SES	2,757	96.61	22.60	162	110.74	18.38	810	112.14	21.04
IQ	1,905	98.60	15.35	132	107.55	13.39	583	111.29	13.53
SCHOOL	2,966	11.75	2.65	172	14.14	1.91	841	13.57	1.65
MARRIED	2,968	0.52	0.50	172	0.48	0.50	841	0.15	0.35
DEPENDS	2,967	0.85	1.19	172	0.60	0.95	839	0.09	0.41
ARMY	2,968	0.21	0.40	172	0.26	0.44	841	0.09	0.29
SMSA	2,968	0.60	0.49	172	0.75	0.43	841	0.63	0.48
SOUTH	2,968	0.29	0.45	172	0.19	0.39	841	0.26	0.44

Source: Derived from data tapes of the NLS, male youths, 1970.

[a]For definition of variables see Appendix.

Table 2. Means and Standard Deviations of Variables for Females, 1970

Variables[b]	Non-Students	All Students	Full-Time Students	Part-Time Student
AGE[c]	20.0439 (2.5010) N = 2256	17.0436 (2.1472) N = 894	16.7335 (1.8228) N = 773	19.5048 (2.7600) N = 105
AGESQ[c]	408.0093 (99.9386) N = 2256	295.0906 (78.7058) N = 894	283.3286 (64.8869) N = 773	387.9810 (107.8745) N = 105
RACE	0.7868 (.4097) N = 2256	0.8009 (.3996) N = 894	.8034 (.3977) N = 773	.7810 (.4156) N = 105
NATLTY	.7247 (.4468) N = 2256	.6857 (.4645) N = 894	.6843 (.4651) N = 773	.6952 (.4625) N = 105
SES	101.1448 (20.5462) N = 2141	113.2135 (20.3217) N = 871	113.1283 (20.3150) N = 756	113.9091 (20.3746) N = 99
IQ	100.2535 (14.8450) N = 2256	107.8803 (14.5334) N = 894	108.2031 (14.5741) N = 773	105.3714 (13.9686) N = 105
SCHOOL	12.2970 (1.6199) N = 2256	12.4743 (1.5834) N = 894	12.3609 (1.4919) N = 773	13.4000 (1.9145) N = 105
MARRIED	.6086 (.4882) N = 2256	.0928 (.2904) N = 894	.0621 (.2415) N = 773	.3238 (.4702) N = 105
DEPENDS	.8187 (1.0510) N = 2250	.0686 (.3163) N = 889	.0404 (.2495) N = 768	.2857 (.5837) N = 105
SMSA	.6662 (.4717) N = 2256	.6175 (.4863) N = 894	.5899 (.4922) N = 773	.8286 (.3787) N = 105
SOUTH	.2416 (.4281) N = 2256	.2204 (.4147) N = 894	.2225 (.4162) N = 773	.1905 (.3946) N = 105

Table 2, continued

Variables[b]	Non-Students	All Students	Full-Time Students	Part-Time Students
YRINC	2058.0876 (2238.6103) N = 2238	650.9009 (1461.9485) N = 888	360.6771 (844.5642) N = 768	2865.3846 (2730.8297) N = 104
LNYRINC	4.7986 (3.9237) N = 2238	2.0982 (3.3829) N = 888	1.6623 (3.0482) N = 768	5.4405 (3.9287) N = 104
HWAGE	2.221 (0.828) N = 1620	1.729 (0.775) N = 659	1.595 (0.637) N = 557	2.589 (0.989) N = 91
LNHWAGE	1.138 (0.254) N = 1620	0.968 (0.265) N = 659	0.926 (0.235) N = 557	1.141 (0.275) N = 91

[a]The first number is the mean, rounded to four decimal points. Standard deviation is in parentheses. Sample number follows standard deviation.

[b]For definitions of variables, see Appendix.

[c]Age and Age squared referto 1968 data. To compare with the male data in Table 1, add 2 to the mean for AGE.

Empirical Results

Regression Analysis. To estimate potential earnings, OLS regressions were estimated for annual earnings, ln (annual earnings), hourly wages, and ln (hourly wages) for both males and females. The NLS tapes contain an impressive list of variables from which one might choose to specify the set of explanatory variables. A number of approaches may be followed in selecting a list of explanatory variables. One would be to conduct a literature survey concerning earnings functions and to select those variables which proved significant in such studies. Another approach is to consider all variables which have a priori relation to earnings, and narrow the list by the use of stepwise regression analysis. The latter approach might be especially fruitful here, since our main purpose is not to test hypotheses about the significance of one or more of the explanatory variables but rather to obtain a predicted value of foregone earnings for students.

We combined the two approaches. Variables used in other studies were considered, along with other variables that were believed to affect earnings. The entire set of data was subjected to stepwise least-squares regression, which helped narrow down the list of explanatory variables. Further, a number of potentially useful and significant variables had to be removed from the equations because their counterparts could not be estimated for students. For example, it is impossible to determine whether a student will be working in a job covered by collective bargaining. It was also not possible to consider work experience, although the inclusion of an age variable is at least a proximate surrogate for experience, when years of schooling are held constant (Mincer 1974).

Table .3 . Regression Coefficients and t -ratios (in parentheses) for Hourly Wages, ln (Hourly Wages), Annual Income and ln(Annual Income), Young males, 1970.

Independent Variables	Dependent Variables			
	Hourly Wage (1)	Ln (Hourly Wage) (2)	Annual Income (3)	Ln (Annual Income) (4)
Intercept	-0.82 (-0.36)	0.20 (0.45)	-9,159.34 (-1.64)	3.40 (1.62)
AGE	-0.04 (-0.22)	0.02 (0.56)	347.80 (0.72)	0.31 (1.41)
AGESQ	0.0038 (0.90)	0.0001 (0.18)	0.29 (0.03)	-0.0076 (-1.34)
RACE	0.23 (2.21)	0.06 (2.73)	1,158.74 (4.47)	0.31 (2.15)
NATLTY	-0.14 (-1.74)	-0.03 (-1.64)	-113.71 (-0.57)	0.14 (1.27)
SES	0.005 (2.38)	0.001 (2.41)	4.86 (0.95)	-0.003 (-1.24)
IQ	0.007 (2.35)	0.001 (2.71)	7.67 (1.12)	0.0001 (0.03)
SCHOOL	0.11 (5.10)	0.02 (4.75)	228.04 (4.31)	0.09 (2.94)
MARRIED	0.52 (6.31)	0.12 (7.22)	1,802.53 (8.94)	0.47 (4.25)
DEPENDS	0.02 (0.39)	0.005 (0.69)	222.30 (2.31)	0.06 (1.22)
ARMY	0.10 (1.19)	0.02 (1.31)	54.02 (0.27)	0.01 (0.07)
SMSA	0.51 (6.84)	0.11 (7.87)	1,241.01 (6.93)	0.37 (3.72)
SOUTH	-0.29 (-3.47)	-0.07 (-4.42)	38.09 (0.18)	0.06 (0.56)
R^2	0.27	0.31	0.29	0.05
F	50.00	60.36	58.27	7.05
N	1,597	1,597	1,764	1,764

Data sources: NLS, Young Males, 1970. Based on data for individuals who are not enrolled in school.

In conclusion, the regression analyses contain the following explanatory variables: age, age squared (to account for observed nonlinearities in the effect of age on earnings), race, nationality, socio-economic status, IQ, number of years of school completed, marital status, number of dependents, military service (for males only), and two locational variables (SMSA and South). The results of the regression analyses are reported in Tables 3 (for males) and 4 (for females).

Concerning the male regressions in Table 3 we find that age and age squared are uniformly nonsignificant, whites earn signiciantly more than nonwhites, additional years of schooling contribute to earnings, married persons earn much more than others, and persons living in SMSAs earn considerably more than those outside an SMSA. The effect of schooling on earnings in Columns (1) and (2) are relatively modest, in comparison with findings by other authors. The results for annual income in Columns (3) and (4) are more nearly in accord with other results in the literature. Note, also, that SES, IQ, and South are significant in Columns (1) and (2) but not in (3) and (4), and that the number of dependents significantly affects annual earnings but not any of the other dependent variables. Finally, although the goodness-of-fit measures (R^2, F) for Columns (1) through (3) are consistent with similar cross-sectional studies, the low R^2 for Column (4) suggests that it may not be appropriate to use the ln of annual earnings to estimate potential earnings.

The female regressions in Table 4 indicate that the structure of female wages is different from the male structure in a number of respects. First, nonwhite females appear to earn more than white females (the reverse is true for males). Second, unlike married men, married females tend

Table 4. Regression Coefficients and t-ratios (in parentheses) for Hourly Wages, Ln (Hourly Wages), Annual Income, and Ln(Hourly Income), Young Females, 1970

Independent Variables	Dependent Variables: Hourly Wage (1)	Ln (Hourly Wage) (2)	Annual Income (3)	Ln (Annual Income) (4)
Intercept	-1.77 (-1.48)	-0.44 (-1.18)	-21,580.20 (-7.98)	-19.14 (-4.61)
AGE	0.086 (0.71)	0.066 (1.74)	1,822.76 (6.64)	2.20 (5.22)
AGESQ	-0.00003 (-0.01)	-0.001 (-1.04)	-38.92 (-5.68)	-0.05 (-4.94)
RACE	-0.087 (-1.61)	-0.026 (-1.54)	-207.38 (-1.64)	-0.46 (-2.38)
NATLTY	-0.21 (-4.87)	-0.06 (-4.48)	-109.28 (-1.08)	0.17 (1.06)
SES	0.0015 (1.38)	0.0004 (1.28)	-0.46 (-0.18)	-0.005 (-1.37)
IQ	0.006 (3.82)	0.002 (4.30)	19.04 (5.41)	0.02 (4.21)
SCHOOL	0.13 (9.33)	0.036 (8.06)	204.29 (5.98)	0.17 (3.20)
MARRIED	0.002 (0.06)	-0.001 (-0.10)	-764.65 (-7.95)	-1.24 (-8.36)
DEPENDS	-0.11 (-4.45)	-0.037 (-4.81)	-805.38 (-15.42)	-1.20 (-14.94)
SMSA	0.256 (6.30)	0.08 (6.47)	347.94 (3.71)	0.28 (1.93)
SOUTH	-0.04 (-0.94)	-0.004 (-0.30)	99.62 (0.96)	0.18 (1.12)
R^2	0.30	0.28	0.31	0.24
F	58.19	53.79	87.09	61.01
N	1,531	1,531	2,117	2,117

<u>Data Sources</u>: NLS, Young Females, 1970. Based on data for individuals who are <u>not</u> enrolled in school.

to work fewer hours and earn less per year than unmarried females. There is no significant difference between the hourly wages of married and unmarried females (in contrast to a highly significant difference for males). Third, with more dependents, males tend to work more hours and earn more income, whereas females appear to earn less per hour and work fewer hours, resulting in a substantial reduction in annual income for each additional dependent. Fourth, SES does not appear to have a significant effect on earnings for females, even though it does appear to affect the hourly wages of males. Finally, residence in the south appears to depress male hourly wages but has no significant impact on female earnings.

Other results in Table 4 are similar to those found for men. Females with higher IQs earn more than those with lower IQs, age and age squared are not statitically significant American-born individuals tend to earn less, other things equal, there are handsome returns to schooling, and persons living in an SMSA earn significantly higher wages and salaries.

Earnings Foregone Per Student. The earnings foregone per student were derived on the basis of the regression equations reported in Tables 3 and 4 and the methodology explained earlier. An example of the derivation of earnings foregone per male student is provided in Table 5.

Column 1 of Table 5 contains the predicted potential income, which is equal to hourly earnings multiplied by 2,000 hours, as in Equation (6). Annual earnings of students

Table 5. Derivation of Estimated Earnings Foregone per Male Student, 1970, Employing the Regression results for Predicting Hourly Earnings

Enrollment Class	Predicted Hourly Earnings x 2,000	Actual Earnings	Earnings Foregone Col. (2) - Col. (3)	N
	1	2	3	4
Full-Time				
Lower Division	$5,703.44	$1,571.31	$4,132.13	213
Upper Division	6,702.26	1,946.51	4,755.75	274
Graduate and First Professional	8,402.46	2,724.07	5,678.39	76
Part-Time				
Lower Division	6,767.52	5,330.31	1,437.21	48
Upper Division	7,960.21	5,795.83	2,164.38	30
Graduate and First Professional	9,072.03	8,964.62	107.41	42

Note: N is the number of students in the NLS Male Youth data tapes upon which the results in the table are based.

(Y_s) are reported in Column 2. Earnings foregone per pupil are the difference between potential income and actual earnings, as in Equation (8), shown in column 3 of Table 5. The table provides estimates of EF/P for each enrollment class: lower - and upper - division undergraduates, and graduates and first professionals, both part-time and full-time.

Earnings foregone per male student in Table 5 vary from a low of only $107 for part-time graduate students to a high of $5,678 for full-time graduate students. Earnings foregone for part-time students are much lower than for full-time students, because the former are likely to be full-time workers. Our data indicate, in fact, that part-time students work, on the average, more hours per year than nonstudents. Since most of the graduate and first professional part-time students are fully employed and pursue their studies after working hours, their foregone earnings are negligible.

Employing similar methods we obtain the information reported in Table 6. A few generalizations are noteworthy:

1. Earnings foregone are highest when it is assumed that H = 2,000.

2. When log earnings or log hourly wages are used, earnings foregone are lower in all cases, and in some case much lower.

3. As noted earlier, earnings foregone of part-time students are much lower than full-time students. In a number of cases, part-time students have no foregone earnings.

4. With a few exceptions, females forego less income than males.

5. With the exception of part-time graduate students, earnings foregone increase as one moves up the educational ladder. Our results suggest that the increase in opportunity costs from lower division to upper division may be as high as, or higher than, 50 percent.

Table 6. Earnings Foregone per Student, 1970

	Method for Estimating Potential Income			
	Annual Earnings	Antilog [Log (Annual Earnings)]	Hourly Earnings x 2,000	Antilog[log(Hourly Earnings)] x 2,000
Males				
Full-Time				
Lower Division	$2,119	$ 711	$4,132	$3,829
Upper Division	3,058	1,158	4,756	4,306
Graduates and First Professional	4,522	2,049	5,678	5,184
Part-Time				
Lower Division	86	0	1,437	1,013
Upper Division	937	0	2,164	1,688
Graduates and First Professional	0	0	107	0
Females				
Full-Time				
Lower Division	1,717	381	3,379	3,189
Upper Division	2,892	2,236	4,170	3,965
Graduate	3,103	3,095	4,583	4,497
Part-Time				
Lower Division	0	0	841	663
Upper Division	1,868	769	3,420	3,225
Graduate	0	0	1,020	846

Total Earnings Foregone. To calculate total earnings foregone to society we need data concerning the earnings foregone per student (as shown in Table 6) and the number of students enrolled in each educational level. Table 7 provides the enrollment data, and the calculations of total foregone earnings appear in Table 8.

The highest estimate of total earnings foregone, ($25,680 million) are obtained when potential earnings are estimated by predicted hourly earnings multiplied by 2,000 hours. Slightly lower figures ($23,480 million) are obtained when the natural logs of hourly wages are used instead. Considerably lower figures ($14,938 million) are obtained when annual earnings are used to predict potential earnings, and the lowest estimates ($6,014 million) are obtained when the natural logs of annual earnings are used instead. The latter estimate is suspect however, due to the low fit of the regression equation in Table 3. If we disregard the estimates derived from the log of annual earnings, than the estimated earnings foregone range from $14,938 million to $25,680 million.

The major difficulty with the calculation of total earnings foregone is the aggregation problem. If our estimates of the earnings foregone per student are accurate, then we can use them with confidence only for marginal cases. If some students choose to go to college rather than to be fully employed, their opportunity cost can be calculated in accordance with our methodology. But when we consider the aggregate of all students (more than 7 million people),

Table 7. Fall 1970 Resident, Degree-Credit Enrollments in Institutions of Higher Education[a]

Type and Level of Enrollment	Male	Female	Total
Full-Time			
Lower Division	1,862,550	1,364,398	3,226,948
Upper Division	1,050,534	716,974	1,767,508
Graduate and First Professional	412,369	130,306	542,675
Total	3,325,453	2,211,678	5,537,131
Part-Time			
Lower Division	605,582	523,954	1,129,536
Upper Division	176,391	131,988	308,379
Graduate and First Professional	374,470	259,927	634,397
Total	1,156,443	915,869	2,072,312
All Students	4,481,896	3,127,547	7,609,443

Source: George H. Wade, Fall Enrollment in Higher Education, 1970: Supplementary Information Data (Washington, D.C.: U.S. Government Printing Office, 1971): Table 2, p. 14.

[a]Enrollments of unclassified students are included in each level of enrollment on the assumption that unclassified students are distributed among levels of education in the same proportion as classified stduents. The total number of unclassified students in 1970 was 358,717.

Table 8. Aggregate Earnings Foregone for College Students, 1970[a]

(Millions of 1970 Dollars)

	Method for Estimating Potential Income			
	Annual Earnings	Antilog [Log (Annual Earnings)]	Hourly Earnings x 2,000	Antilog [log (Hourly Earnings)] x 2,000
Males				
Full-Time				
Lower Division	$3,947	$1,324	$7,696	$7,131
Upper Division	3,212	1,217	4,996	4,524
Graduates and First Professional	1,865	845	2,342	2,138
Part-Time				
Lower Division	52	0	870	614
Upper Division	165	0	382	298
Graduates and First Professional	0	0	40	0
All Male Students	9,241	3,386	16,326	14,705
Females				
Full-Time				
Lower Division	2,343	$ 520	4,610	4,351
Upper Division	2,073	1,603	2,990	2,843
Graduate and First Professional	404	403	597	586
Part-Time				
Lower Division	0	0	441	347
Upper Division	247	102	451	426
Graduate and First Professional	0	0	265	220
All Female Students	5,697	2,628	9,354	8,775
Grand Total	$14,938	$6,014	$25,680	$23,480

[a]Each entry in the table is derived by multiplying the respective earnings foregone per student (from Table 6) by the total enrollment for this category (from Table 7). For example, the entry in the first column and first row (male full-time, lower division, using predicted annual earnings to estimate potential income) is derived by multiplying $2,119 times 1,862,550 = $3,946,743,500. Numbers in the table were rounded to the nearest million.

the aggregate results imply that market wages would remain essentially intact even if all of the students chose to work rather than study. Such an assertion is difficult to accept, hence the aggregate estimates of earnings foregone must be viewed with some skepticism.

COMPARISON WITH OTHER STUDIES

Our results for both earnings foregone per student and aggregate earnings foregone for the United States differ from those of other studies. The differences are due to variations in methodology, data base, and (for aggregate results) differences in the definition of college enrollments. Although all of the studies of which we are aware use official enrollment data, there are different measures of "enrollments" one might use. For instance, one could use "full-time equivalent" enrollment, total head-count enrollment, degree-credit enrollment, and resident degree-credit enrollment. Each of these measures would produce a different number for total enrollments, resulting in different total earnings foregone estimates, other things equal.

The best-known method to measure earnings foregone is the Schultz method. Detailed in Schultz's classic article (1960; see also Schultz, 1971, pp. 82-90), the technique is relatively simple. Earnings foregone per pupil are equal to the equivalent of 25 weeks of average wages in manufacturing.

Table 9. Comparison of Earnings Foregone Per Students Derived in Different Studies, 1970 (College students only)

	Schultz's Method	Schultz's Method Adjusted	Kagann (BLS data)	Freeman (CPS data)	Crary & Leslie	Cohn	
						High Estimate	Low Estimate
All Students	$3,343.25	$2,850	$4,701			$3,374	$1,963
Males Only						3,643	2,062
Undergraduates			4,612	$2,980		3,774	1,996
Graduates			8,220			3,027	2,370
Females Only						2,991	1,822
Undergraduates			4,062			3,102	1,934
Graduates			6,595			2,209	1,035
Males and Females							
Lower-Division					$2,153	3,126	1,456

<u>Sources</u>: Schultz's results are derived from Cohn (1979), Table 4-6. Kagann's results are from Kagann (1975), Tables VIII and X. Freeman's results are from Freeman (1980), Table 5. Leslie and Crary's results are from Leslie and Crary (1978), Tables 3 and 4. And Cohn's results are weighted averages of results reported in Table 6 of this paper. The precise derivation of the estimates presented in this table is explained in the text.

The magic number (25 weeks) was arrived after extensive analyses of the wages of young men and women, both those enrolled in school and those who are fully employed. The Schultz results for the base year (1949) are probably fairly reliable, but it is not clear whether the 25-week factor could be used for subsequent years.

The adjusted Schultz method, as developed by this author (Cohn, 1979, chapter 4), takes into account changes in the full-time and part-time composition of the student body. The adjusted per-student estimate is given by the following formula:

Adjusted EF/P = (Unadjusted EF/P x FTE Enrollment)/ total enrollment.

Since FTE enrollment is always less than total enrollment, the adjusted EF/P is necessarily smaller than the unadjusted EF/P.

As is shown in Table 9, there is a close resemblence between the Schultz (unadjusted) estimate and the high estimate derived from our present analysis. The two estimates are, in fact, so close that aggregate foregone earnings differ by only $240 million, or less than 1 percent. If we accept the argument that earnings foregone should represent the full 2,000 hours of work, then the Schultz method yields accurate results. If, on the other hand, something less than 2,000 hours is more appropriate, then the adjusted Schultz method would be superior. Note, however, that the Schultz estimates differ significantly from our low estimates.

Our low estimates might be more in line with Parsons' (1974) procedure, where it is assumed that students forego 1300 hours of work and leisure annually.

Much higher estimates than provided either by any of our estimates or by the Schultz methods have been derived by Kagann (1975) who used Bureau of Labor Statistics (BLS) data. His estimate of earnings foregone per student,[5] for all students, is $4,701, compared to our high estimate of only $3,374. Similar to our estimates, however, are the relations between male and female earnings foregone per pupil. But his high estimates for graduate students appear excessive, in light of the large fraction of part-time students among the graduate group.

Another estimate is provided by Freeman (1980), using the Current Population Survey (CPS) tapes. Since Freeman does not report estimates for 1970, it was necessary to interpolate his results for 1968 and 1973 to obtain estimates comparable with ours. Also, since his earnings are measured in terms of 1977 dollars, it was necessary to make adjustments for changes in price levels. Also, Freeman's estimates are only for undergraduate males. The results obtained from Freeman's data - $2,980 per student - are about midway between our high and low estimates. Although our high estimate might be a slight overestimate, it is our opinion that Freeman's estimate is slightly too low. Using a higher estimate of

[5]Kagann does not offer an over-all estimate of earnings foregone per student, but the estimates reported in Table 9 of this paper could easily be inferred from his tables.

earnings foregone could alter some of Freeman's work concerning the internal rate of return to college education.[6]

The final comparisons in Table 9 concern estimates reported by Crary and Leslie (1978), who used the National Longitudinal Survey of the High School Class of 1972. They provide estimates of foregone earnings for freshmen (1972-73) and sophomores (1973-74). The estimates are provided by attendance status and type of institution (4-year and others), as well as by SES and ability level. The figure displayed in Table 9 is the weighted average of the average earnings foregone reported in Crary and Leslie's Table 4 (p. 27), which was adjusted to reflect changes in the price levels between 1970 and 1973. We note that Crary and Leslie's estimates are about $1,000 per student less than our high estimate for all lower-division students, and about $700 higher than our low estimates. One major advantage of the Crary and Leslie study is the use of an excellent data source, which includes a very large sample of both nonstudents and students at the freshman level, and a fairly large sample of nonstudents and (considerably fewer) students at the sophomore level. Crary and Leslie also attempted to match students and nonstudents, following to some degree the method suggested here. But they fell short of the full implementation of the concept, because too many important variables (e.g., age, sex, race and marital

[6]Freeman reports alternative estimates by Cohn, referring to my 1979 book. It is not clear how these estimates were derived, since I did not report such estimates anywhere. He also reports some estimates by Witmer, which are considerably lower than Freeman's. I agree with Freeman that Witmer's figures are unreasonably low.

status) have been excluded from the analysis, and because their study was confined to freshmen and sophomores. Finally, no data are presented for part-time students.

One interesting feature of the Crary and Leslie article is the estimation of earnings foregone cross classified by SES and ability level. A more detailed examination of the earnings foregone could be made with our data. It is possible to calculate estimates of earnings foregone for any combination of the explanatory variables in Tables 3 and 4. To illustrate the possible extensions of the analysis, we report in Table 10 the net effect on earnings foregone of a unit change in any of 10 explanatory variables, when other variables remain constant. Column 1 is derived from Column (3) of Table 3, whereas Columns 2 is derived from a regression equivalent to the one upon which Column (1) is based, but using data for full-time male students. Column 3 is simply the difference between Columns 1 and 2. For example, a white, full-time male student is expected to have earnings foregone of $927 in excess of an otherwise equivalent nonwhite. And an individual born outside the United States and Canada is likely to have earnings foregone of $273 less than those born in the United States or Canada. Similar statements may be made with respect to the remaining variables.

It should be pointed out that the studies reported in Table 9 do not exhaust the literature in the area. Other studies which might be of some interest include Blitz (1962), Machlup (1963), Becker (1964), and Solmon (1971).

Table 10. Effect of a One-unit Change in Each of 10 Variables on Potential Earnings, Actual Earnings, and Earnings Foregone of Full-Time Male Students, 1970

Variable	Effect of a one-unit Change in Variable on Potential Earnings	Actual Earnings	Earnings Foregone
RACE	$1,159	$232	$ 927
NATLTY	-114	159	-273
SES	4.9	- 0.4	5.3
IQ	7.7	-10	17.7
SCHOOL	228	-165	393
MARRIED	1,803	588	1,215
DEPENDS	222	568	-346
ARMY	54	90	- 36
SMSA	1,241	407	834
SOUTH	38	65	- 27

Note: Each effect is based on the assumption that other variables remain constant.

CONCLUDING COMMENTS

The results shown in this paper suggest that earnings foregone per student vary greatly between males and females, part-time and full-time students, and between levels of enrollments. Overall earnings forgeone per student in 1970 are estimated to fall somewhere between $1,963 and $3,374, which translate into aggregate earnings foregone for the United States of between $14.94 billion and $25.68 billion. Given that part-time students work,on the average, between 1400 (for females) and 1900 (for males) hours per year, the use of the 2,000- hour yardstick may represent only a slight overstatement, hence the appropriate figure should be close to our high estimate. As shown in Table 9, this conclusion vindicates the Schultz method, at least in so far as the year 1970 goes. Additional work should be done for subsequent years, using the NLS and other data sets, especially the National Longitudinal Survey of the High School Class of 1972 and its follow-up surveys, which were not available to the author.

A number of issues remain unresolved. For example, what should be the proper estimation methodology? (We provided four different regressions). Should we make an adjustment for unemployment? (See Cohn, 1978, for a discussion of this issue.) How should we handle the aggregation effect? What is the proper student enrollment count that should be employed to obtain the aggregate estimate of earnings foregone? Further studies designed to overcome these and other problems are certainly in order.

We conclude this paper with a projection of our results into 1975 and 1980, as shown in Table 11. The high estimates of earnings foregone per pupil are derived by multiplying the Schultz-type estimate by the factor 1.0123, which represents the ratio of our high estimate to the Schultz estimate for 1970. The resulting high estimate is multiplied by a factor of 0.5818 to obtain the low estimate of earnings foregone per pupil, based upon the ratio of our high and low estimates for 1970. These estimates are then multiplied by the estimated resident, degree-credit enrollment in insitutions of higher education to obtain the aggregate foregone earnings in current dollars. Our calculations indicate that estimated earnings foregone of college students in 1980 range from $42.69 billion to $73.37 billion.

Table 11. Projected Earnings Foregone for 1975 and 1980 and Estimated Earnings Foregone for 1970 (in Current Dollars)

Year	Average Weekly Wages in All Manufacturing x 25 Weeks	Earnings Foregone per Student		Estimated Resident Degree-Credit Enrollment	TOTAL Earnings Foregone	
		High Estimate Col. 1 x 1.0123	Low Estimate Col. 2 x 0.5818		High Estimate Col.2 x Col. 4	Low Estimate Col.3 x Col. 4
	1	2	3	4	5	6
1970	$3,333	$3,374	$1,963	7,609,443	$25.68 billion	$14.94 billion
1975	4,710	4,829	2,810	9,349,669	45.15	26.27
1980	7,216	7,305	4,250	10,043,891	73.37	42.69

Sources: For Column 1, Economic Report of the President (1982), P. 277. For Column 4, Grant and Eiden (1982), p. 95, adjusted for non-resident enrollment.

APPENDIX

DESCRIPTION OF VARIABLES

Variable Name	Variable Description
AGE	Age of respondent.
AGESQ	AGE x AGE.
RACE	= 1, for whites = 0, otherwise
NATLTY	= 1, for U.S. or Canadian born = 0, otherwise
SES	Duncan index of occupation of head of household when respondent was 15 years old. Used as an index of socioeconomic level of parent.
IQ	IQ score. Measure of intelligence.
SCHOOL	Highest grade respondent has completed.
MARRIED	= 1, if married, spouse present = 0, otherwise
DEPENDS	Number of dependents, excluding spouse.
SMSA	= 1, if living in a Standard Metropolitan Statistical Area = 0, otherwise
SOUTH	= 1, if living in the South Atlantic or East-South Central Region = 0., otherwise

APPENDIX - Continued

Variable Name	Variable Description
ARMY	= 1, if respondent served in the Armed forces = 0, otherwise
YRINC	Income from wages and salary in 1970 dollars.
LNYRINC	Natural logarithm of YRINC.
HWAGE	Hourly wage of respondent, in 1970 dollars.
LNHWAGE	Natural logarithm of HWAGE

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