NBER WORKING PAPER SERIES

DOES IT PAY TO ATTEND AN ELITE PRIVATE COLLEGE? CROSS COHORT EVIDENCE ON THE EFFECTS OF COLLEGE QUALITY ON EARNINGS

Dominic J. Brewer
Eric Eide
Ronald G. Ehrenberg

Working Paper 5613

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
June 1996

We thank Randy Hill and Matt Sanders for research assistance. We are grateful to Kathryn Ierulli, Jeff Grogger, seminar participants at Brigham Young University and Vasser College, and participants at the Society of Labor Economists Conference, Chicago, IL, May 3-4, 1996, for helpful comments on an earlier version. Brewer was supported by RAND's Institute on Education and Training with funding provided by grants from the Lilly Endowment and the Sloan Foundation. This paper is part of NBER's research program in Labor Studies. Any opinions expressed are those of the authors and not those of the National Bureau of Economic Research.

NBER Working Paper 5613
June 1996

DOES IT PAY TO ATTEND AN ELITE PRIVATE COLLEGE? CROSS COHORT EVIDENCE ON THE EFFECTS OF COLLEGE QUALITY ON EARNINGS

ABSTRACT

While there is evidence of a substantial and rising labor market premium associated with college attendance in general, little is known about how this premium varies across institutions of different quality and across time. Previous research which has estimated the return to college quality has not taken into account that individuals likely select the type of college they attend based in part on the expected economic return and net costs. In this paper we explicitly model high school students' choice of college type (characterized by quality and control) based on individual and family characteristics (including ability and parental economic status), and an estimate of the net costs of attendance and expected labor market return. We estimate selectivity corrected outcome equations, using data from both the *National Longitudinal Study of the High School Class of 1972* and *High School and Beyond*, which permit us to determine the effects of college quality on wages and earnings and how this effect varies across time. Even after controlling for selection effects there is strong evidence of significant economic return to attending an elite private institution, and some evidence that this premium has increased over time.

Domenic J. Brewer
RAND Corporation
1700 Main Street
Santa Monica, CA 90407

Eric Eide
Department of Economics
Brigham Young University
Provo, UT 84601

Ronald G. Ehrenberg
Industrial and Labor Relations
Cornell University
Ithaca, NY 14853-3901
and NBER

1. Introduction

Previous research has shown that the labor market return to college overall has fluctuated: for example, between the mid-1970s and the mid-1980s the proportionate difference in mean wages between male college graduates and male high school graduates grew by 15 to 30 percentage points (Bound and Johnson, 1992; Katz and Murphy, 1992; Levy and Murnane, 1992). It is not known whether this higher return applies uniformly to attendees of all types of four year college, or only to those at certain types of institutions. In particular, there is limited evidence on the relationship between college quality and labor market outcomes (Brewer and Ehrenberg, 1996; Daniel et al., 1995, Behrman et al., 1995), Loury and Garman, 1995; James et al., 1989), and none on how the return to college attendance has changed for different cohorts of students, or how the return varies over time for individuals in a given cohort. In this paper, using data from the *National Longitudinal Study of the High School Class of 1972* (NLS72) and *High School and Beyond* (HSB), we are able to examine the effects of college quality on hourly wages and annual earnings of college attendees from the high school graduating classes of 1972, 1980, and 1982 at various stages in the lifecycle: six years after high school (for the 1972 and 1980 cohorts), ten years after high school (for the 1982 cohort), and fourteen years after high school (1972 cohort).

In addition to standard wage/earnings regressions similar to those used in prior research, we estimate the return to college quality in the context of a structural model in which we explicitly assume that choice of college quality is determined in part by the expected labor market payoff and the net costs (tuition costs less financial aid) that individuals face at different types of colleges. Estimation of a reduced form college choice model permits calculation of selectivity terms which reflect the probability that the college type observed for any individual was in fact chosen (Lee, 1983). These selectivity terms are used to "correct" models predicting the wage rates or earnings of college attendees, estimated separately for each college quality type.

We find evidence of a large labor market premium to attending an elite private institution, and a smaller premium to attending a middle rated private institution, relative to a bottom-rated public school. There is weaker evidence of a return to attending an elite public university. Our analysis suggests the return to elite private colleges increased significantly for the 1980s cohorts as compared

to the 1972 cohort. We also find that in general modelling the effects of college quality in the context of a structural model of college choice does not affect our estimates. These are important findings in light of the large tuition increases concentrated at elite institutions during the past 15 years which, combined with declining federal student financial aid, has given rise to increased concern about how to finance a college education (McPherson and Schapiro, 1991).

2. Modelling the Effects of College Quality on Labor Market Outcomes

There have been several previous studies examining the relationship between college quality and wages or earnings.[1] The basic methodology employed in prior analyses is similar. The logarithm of individual i's (weekly or annual) earnings or hourly wage rate ($\ln W_i$) is regressed on a set of his or her characteristics (X_i) and a set of college characteristics for the school j he or she actually attended (Z_{ij}).

$$\ln W_i = \beta_0 + \beta_1 X_i + \beta_2 Z_{ij} + \mu_i \qquad \mu_i \sim N(0,\sigma^2) \tag{1}$$

College quality measures are included in Z, often simply in the form of a single variable or set of dummy variables indicating college quality, with the estimated β_2 interpreted as the effect of college quality on earnings. College "quality" is most commonly measured by indicators of selectivity of the undergraduate body (such as the average SATs of entering freshmen) or by resource measures (instructional expenditures per student, library size, and faculty per student).[2] This research finds that attending a higher quality college raises wages/earnings, ceteris paribus, though the magnitude

---

[1] A detailed summary of each of these may be found in Brewer and Ehrenberg (1996). The studies are: Weisbrod and Karpoff (1968), Reed and Miller (1970), Wales (1973), Solmon, (1973, 1975), Solmon and Wachtel (1975), Wise (1975), Wachtel (1976), Griffen and Alexander (1978), Morgan and Duncan (1979), James et al. (1989), Kingston and Smart (1990), Fox (1993), Loury and Garman (1995) and Daniel et al. (1995).

[2] Kingston and Smart (1990) note that there is little change across time in institutional rankings, and Solmon (1975) shows the high degree of correlation among numerous alternative measures. Conrad and Blackburn (1985) discuss the various methods by which departments and institutions have been classified in prior research.

of the estimated effect varies from negligible to large.

This simple methodology has a potential weakness: it does not take account of the systematic selection of college quality on the basis of the expected labor market payoff to attending it. There is considerable variation in tuition costs associated with colleges of different quality; in general, more selective private institutions charge higher tuition than their less selective private counterparts, and private institutions are more expensive than public ones of similar quality. Why do students choose to attend higher quality institutions despite these higher charges? Why do they attend high cost private institutions when comparable quality public institutions are available? Presumably, the answer is partly that attendance at these colleges is expected to yield a greater economic payoff in the labor market, net of higher attendance costs, on termination of college. If individuals invest in college quality on the basis of expected returns, college quality cannot be treated as an exogenous determinant of earnings..[3]

In this paper we utilize a generalization of Willis and Rosen's (1979) selectivity model applied to the college quality context. The structural model consists of a choice equation and an estimated outcome equation for each choice. Individuals are assumed to select a public or private college in an observable quality category j (= 1,...,K) which yields them the highest utility over the lifecycle. The utility of a college choice for individual i is hypothesized to be a linear function of the expected lifetime pecuniary (Y) returns derived from attending college category j, the net direct costs (C) of college category j, the individual's characteristics (X), and an individual specific taste shifter ϵ.[4] Net costs in this context refers to the difference between the tuition and financial aid an individual student would face were they to attend college type j. Personal characteristics may affect utility differently for different options (δ_{ji} does not necessarily equal δ_{ki} in equation (2) below).

---

[3] There are a host of other problems with prior studies. These include the use of unrepresentative samples and reliance on linear measures of quality. Some have treated within-college individual characteristics, which may depend on college quality, as exogenous in wage models . For example, Loury and Garman (1995) include college major and GPA in their earnings models even though it seems likely that these attributes may be correlated with institutional quality and unobserved individual attributes. See Brewer and Ehrenberg (1996) for a discussion. See Grogger and Eide (1995) for evidence on the returns to college major.

[4] Nonpecuniary returns are ignored.

(2) $$U_{ji} = u(Y_{ji}, C_{ji}, X_i, \varepsilon_i) = \delta_0 + \delta_{j1} X_i + \delta_2 Y_{ji} + \delta_3 C_{ji} + \epsilon_{ji}.$$

College category j is chosen if :

(3) $$I_i^* = U_{ji} - U_{ki} > 0 \quad \forall\ k.$$

The structural model consists of (2), (3) and (4):

(4) $$Y_{ki} = \beta_o + \beta_{k1} X_i + \upsilon_{ki} \quad \forall\ k.$$

Assume the log wage rate (ln W) for each individual is the outcome of interest. Combining (4) with (3) and (2) yields a reduced form estimating equation of the form:

(5) $$I_i^* = d_0 + d_{j1} X_i + d_2 C_{ji} + d_3 C_{ki} + \zeta_i.$$

Choice of college quality category depends on individual characteristics and the direct costs associated with both the college quality type chosen, j, and those *not* chosen. In other words, individuals are assumed to compare the net direct costs (and wage outcomes in the structural model) associated with each of six sector/quality college types. Assuming ζ is independently and identically distributed and has a type I extreme value distribution, (5) represents a multinomial logit model.

Since wages are observed only for those who actually chose each type of college, the estimated coefficients of a standard wage equation (like (1)) will not be consistent. The appropriate "selectivity correction" term for each individual (λ), which reflects the predicted probability that an individual selects a particular college quality type, computed using the methodology developed by Lee (1983) and derived from the reduced form choice model, may be used to obtain selectivity corrected estimates of log wages from each choice. In this case (6), the estimated "b"s are consistent.

(6) $$\ln W_{ji} = b_0 + b_{j1} X_{ji} + b_{j2} \hat{\lambda}_{ji} + e_{ji} \qquad j = 1 \ldots 6.$$

These selectivity terms are identified by functional form, and by the inclusion of net costs in the college choice equation (5). That is, net college costs are assumed to determine the college quality chosen but not wages received subsequently.

The labor market returns to college quality can be calculated using the predicted log wages obtained from the estimation of (6). We derive mean predicted wages for individuals who attended each type of college, corrected for choice of college type, and calculate the differentials associated with each college type. Finally, it is possible in principle to determine if the underlying hypothesis of our model that college quality and labor market outcomes are jointly determined by estimating the structural college choice model. This can be done by substituting the predicted wages for all individuals in the sample obtained by (6) into (5).

$$I_i^* = d_0 + d_{ji}X_i + d_2C_{ji} + d_3C_{ki} + d_4\ln\hat{W}_{ji} + d_5\ln\hat{W}_{ki} + \varphi_i \qquad (7)$$

3. Data

In the limited literature on the effects of college quality on labor market outcomes, no study has been able to utilize data which permit the comparison of the differential effects of college quality on labor market outcomes over time. We use two nationally representative sources for our data on college students: *The National Longitudinal Study of the High School Class of 1972* (NLS72) and *High School and Beyond* (HSB), both conducted by the National Center for Education Statistics. These data were explicitly designed for cross cohort analysis.[5] They contain detailed individual, family, and schooling characteristics for three cohorts of students: approximately 21000 who graduated high school in 1972, and over 10000 students who graduated high school in 1980, and in 1982 (1980 high school sophomores). Information regarding college attendance, graduate school attendance, and post-high school wages and/or earnings was collected in a series of subsequent surveys.

Characteristics of colleges are obtained from various components of the *Higher Education*

[5] There are some minor differences in the definition and construction of several variables across cohorts such as the composite test score, high school GPA and high school athletic status.

General Information Survey (HEGIS). This includes the state in which the college is located, its form of control (public/private), tuition levels, and undergraduate enrollment. Throughout our analyses, we employ a six fold classification of college quality type, derived from various editions of Barron's *Profiles of American Colleges.*[6] These ratings are based primarily on selectivity of admissions decisions.[7] We divide institutions into three groups based on a rating of most competitive or highly competitive ("top" or "elite"), very competitive or competitive ("middle"), and less competitive or non competitive ("bottom").[8] We distinguish between privately and publicly controlled institutions in each category. Our samples consist of institutions in each quality/sector grouping for which nonmissing enrollment and tuition data and a Barron's rating are available. There were 79 (56) elite institutions in 1972 (1982), 72 (51) of which were under private control. Tuition was about four times higher at private schools than at publics in 1972 and 1982. The largest percentage increase (118%) in tuition which occurred between 1972 and 1982 was at top private schools; over the same period the Consumer Price Index rose by 117%. In contrast, tuition rose at top publics by 87.5%, and just 71.2% at bottom publics. The large increases in college tuition and fees occurred during the 1980s which are *not* captured in our data.

Nationally representative estimates of attendee characteristics are shown in Table 1 for the high school classes of 1972 and 1982, by type of college attended. The patterns within a cohort are clear. White students and students with higher family incomes, and more educated parents are more likely to attend higher quality colleges. Not surprisingly, those with greater academic talent (higher high school GPAs and test scores) predominate at high quality schools. Females, Hispanics, and blacks are much more likely to be attending top and middle quality schools, both public and private, in 1982 as compared to 1972. Finally, financial aid (from any source) is about twice as high for students attending private institutions than public, with a larger fraction of students at public

---

[6] There is some evidence in previous research that a categorical measure of college quality is to be preferred to a single linear measure (Kingston and Smart, 1990).

[7] Colleges are rated by *Barron's* on the basis of entering students' class rank, high school grade point average, average SAT scores, and the percentage of applicants admitted (see Fox, 1993, p.138).

[8] This threefold categorization is employed primarily because there are too few public institutions in the most competitive group.

institutions receiving no aid. However, more students were receiving some aid in 1982 than in 1972 (as shown by the proportion receiving no aid in the last row of the table).

4. Results

Estimating Samples

In examining labor market outcomes we utilize three cohort samples from NLS72 and HSB. We use the fourth (1979) and fifth (1986) NLS72 followups, which provide up to 3 and 10 years of labor market experience for those students who initially attended a four year college after high school and subsequently completed college in four years. For HSB we concentrate our attention on the 1982 cohort for whom the restricted 1992 (fifth followup) survey provides up to 6 years in the labor market.[9] In some instances, we also use the 1986 (third followup) survey for the 1980 cohort, providing a maximum of 2 years labor market experience for those completing college.[10] In principle, use of more than one cohort permits us to determine if there are systematic differences in the college quality -- outcome relationship in the 1970s and 1980s. We confine our attention to those students who attended a four year college upon completion of high school, regardless of final graduation.[11] After eliminating missing values and merging all necessary data our sample sizes are

---

[9] The NLS72 fourth followup was conducted in the *fall* of 1979 and fifth follow-up was conducted in the *spring* of 1986. (The sample sizes are small because we rely mostly on fifth follow-up data for which only two-thirds of the original sample were surveyed.) The HSB surveys were conducted in the *spring* of each year.

[10] Only the 1982 cohort of high school students were resurveyed in 1992. Some results for the 1980 cohort have been previously reported in Brewer and Ehrenberg (1996).

[11] Our estimates of rates of return to college quality should be viewed as partly reflecting the increased likelihood of graduating from an elite institution. One could include final education level in these outcome models but it is likely endogenous. Prima facie evidence for this may be seen for the 1980 cohort: by 1986, 28% (30%) of those 1980 high school seniors initially attending top private (public) colleges had not received a Bachelors degree; the figures were 50% and 55% for middle private and public schools, and 59% and 70% for bottom privates and publics. Also, Brewer and Ehrenberg (1996) find some evidence that undergraduate college quality affects the likelihood of graduate school attendance. In principle it may be possible to empirically model the endogeneity of educational attainment but finding suitable instruments is problematic. Similarly, confining attention

a maximum of 3062 for the 1972 cohort and 2165 for the 1982 cohort. In each case slightly under half of all students attend middle rated public institutions (1416 in 1972, 954 in 1982). One noteworthy feature of our samples is that relatively few students attend top public schools (22 in 1972 and 35 in 1982) (and similarly for bottom privates in 1982), leading to difficulties in estimation. Sample means and standard deviations for the major variables used in our analyses are shown in Appendix Table 1.

Pooled Wage/Earnings Models

We now turn to our estimates of the effect of college quality/sector on labor market outcomes. The preferred measure of labor market performance is the logarithm of the hourly wage rate for those employed. This is available for the 1972 cohort for those working in 1979 and those working in 1986. However, for the 1982 HSB cohort, data on hourly wage rates were not collected in the 1992 followup; rather annual earnings information was gathered. Unfortunately, *no information on hours or weeks worked* was collected, so it is impossible for this group to separate labor supply decisions from wages, so the earnings measure muddies the interpretation of the effects of college quality. It is also particularly problematic for women who are less likely to be employed full time than men. Since college quality may be positively correlated with hours worked and weeks worked, as well as wage rates, we might expect the estimated effects of college quality on earnings to be larger than the estimated effects of college quality on wages. We use the logarithm of annual earnings in 1992 for the 1982 cohort.[12] In order to reduce possible errors arising from this earnings measure we also estimate all the models separately for men only, and as an additional point of comparison we also utilize information on 1986 hourly wages for the 1980 cohort of high school

---

to graduates only reduces sample sizes dramatically making implementation of our model difficult with these data.

[12] We do not restrict the range of possible earnings values, save that reported earnings are positive. Preliminary results did not suggest our results were sensitive to this decision; restricting the sample is essentially arbitrary and further reduced sample sizes which makes estimation of our structural model problematic.

graduates, and report annual earnings models for the 1972 cohort.[13]

The simplest analysis of the effects of college quality on labor market outcomes is to estimate pooled models as given by equation (1) in Section 2, in which dummy variables indicating the college quality/sector each student attended are included in a standard log wage/earnings model estimated for all college attendees.[14] This is the approach taken in most previous research, although none has focused on the issue of sectoral control or examined cross cohort or within cohort differences as we are able to do. Results of this exercise are shown in Table 2.

We show five alternative labor market outcome measures for our three cohorts. The results are striking. In all cases, attendance at an elite private institution is associated with a statistically significant and sizeable wage premium relative to bottom publics, the omitted group. There is some evidence that this premium increases over time for a given cohort. For those in the 1972 cohort attending a top private school, hourly wages were 9% higher in 1979 but 14% higher in 1986; however this change is not statistically significant. A similar pattern is also exhibited for other college types for the 1972 cohort; the within cohort change is statistically significant for middle privates and top publics. With less certainty (since one is forced to compare wage and earnings models) this pattern holds for the 1980/1982 cohorts.

There is also evidence that the premium to attending an elite institution increased for the cohort that attended college in the 1980s compared to those who attended in the 1970s.[15] For

---

[13] NLS72 contains sufficient information to construct an earnings measure comparable to the 1992 HSB earnings variable.

[14] These models include female, Hispanic, black, family size, family income, father's education, mother's education, test score, and dummies indicating if the individual was employed part time, was still an undergraduate, or a graduate student. The models are estimated for those individuals in our sample with positive wages or earnings. We correct for employment selectivity using a standard Heckman (1979) procedure. In other words, we estimate a probit model for employment status using the whole sample, calculate selectivity terms and add these to our wage/earnings model. The term is identified by the inclusion of marital status and number of children at the relevant survey date in the employment status equation, and by functional form.

[15] Across cohorts, the change for 1979 wages/1986 wages is statistically significant for top privates, middle privates, and top publics. For 1986 earnings/1992 earnings the change is

example, at comparable points in the lifecycle (6 years after high school graduation) the premium to a top college was 20% for the 1980 cohort and 9% for the 1972 cohort. Despite having fewer potential years in the labor market, the 1982 cohort enjoyed annual earnings an estimated 37% higher at elite privates than those attending bottom publics in 1992, while those attending this type of college in 1972 received a 15% premium in 1986. There is weak evidence that a similar story is applicable to top publics although the small number of attendees at these institutions suggest that these results should be treated with caution; however, the pattern of increasing labor market returns is not replicated for middle and bottom rated institutions.[16]

Selectivity Corrected Wage/Earnings Differentials

The estimates reported in Table 2 do not control for the possibility that students systematically select a college quality/sector type on the basis of the expected labor market payoff. Our structural model involves the estimation of a reduced form multinomial logit college quality choice model, calculation of selection correction terms from this model, and the inclusion of these in wage/earnings models estimated separately for each college quality/sector group. Here, since our primary focus is on the resulting predicted wage/earnings derived from this procedure, we describe our methodology only briefly. (A complete set of results are available from the authors upon request.)

Initially we calculate the net costs of all six alternative college quality/sector groups which an individual might attend. For tuition, we rely on the fact that a majority of individuals attend a college in the state in which they went to high school.[17] For each state we calculate the mean tuition

---

statistically significant for top and bottom privates.

[16] A similar pattern is observed when the estimating samples are confined to males only, although the returns to elite privates are higher for women than men.

[17] HSB does not directly identify the state of each individual's high school; it is possible to infer the state using an algorithm used by us elsewhere (Ehrenberg and Brewer, 1994). The extent to which students attend a college in the state in which they went to high school varies across college type. For example, 85% of those at public colleges in the 1980 cohort [86% in the 1982 cohort] came from within the state (67% [67%] at top, 83% [84%] at middle, and 88% [89%] at bottom rated schools) compared to 58% [54%] of students at private schools (40% [29%] at top, 62% [50%] at middle and 57% [58%] at bottom rated schools).

(weighted by enrollment) in the relevant year for each type of college, i.e., in top public institutions, middle public, etc., and match this figure to the student's high school state. For public colleges we use in-state tuition figures. If no institution exists in a particular quality/sector group (typically top public and top private) for a state we use a regional mean instead.[18]

Financial aid, disbursed through a variety of federal, state, and institutional programs, is determined largely by academic and/or athletic merit, and by family financial status.[19] The aid an individual with given characteristics receives is determined by the policies an individual institution pursues including its tuition policies. NLS72 and HSB contains the (self reported) financial aid a student received in the college he or she actually attended in the initial year of attendance. We use this information to construct estimates of annual predicted financial aid each individual in the sample *would have* received in each of the six types of college. For those attending each type of institution, this was done by regressing actual aid received on individual characteristics including sex, race/ethnicity, academic ability (proxied by high school GPA and a test score measure), high school athletic status, parental income and family size. We also include a set of dummies for the state in which the colleges attended are located to reflect price variation and differences in state aid policy.[20] Coefficient estimates from these models are then used to construct predicted aid in that college type for all individuals in our sample.[21] Since many individuals receive zero aid a maximum likelihood tobit

---

[18] We experimented with various definitions for the relevant tuition facing each student. For example, use of regional means for the elite institutions, and out of state tuition for top public schools. The reported results are not sensitive to use of these alternatives.

[19] By financial aid we are referring exclusively to direct current income received from federal sources such as BEOG or Pell grants, ROTC scholarships, etc., as well as aid from state, institutional, and private sources. This includes scholarships, fellowships, grants and benefits, but excludes loans.

[20] Note that net costs vary across *individuals* due to differential financial aid eligibility and high school location. Predicted financial aid models are identified by including high school athletic status and state dummy variables for college location (reflecting differences in state aid policy) in the tobit aid model but not in the college choice model. Strictly speaking, these financial aid models should also be corrected for potential selectivity bias, but we do not attempt to do this here.

[21] In other words, while the models are estimated separately for each sector/quality group, the coefficient estimates are used to generate out of sample predictions for those who actually attended

specification is used to obtain these predictions.[22] Estimates of tuition and financial aid are combined to produce the predicted net costs each individual in our samples would face in each college quality/sector type.

High school students are assumed to select a college from the six college sector/quality groups on the basis of the net costs associated with each type of institution and individual characteristics such as sex, race/ethnicity, family income and parental education levels, high school GPA and NLS72/HSB test score. We include two additional variables in the model to proxy for the likelihood of being admitted to a particular institutional type: the availability of college openings ("slots") in each sector/quality group in the high school student's state[23]; and the student's own NLS72/HSB test score minus the mean test score in the institution type actually attended squared (the "test score difference").[24] The estimated reduced form college choice model is used to generate selectivity terms for each type of college.[25]

---

other types of institution. In all cases we use predicted aid.

[22] We find that the amount of financial aid received is related to family economic status and ability, though with some significant differences across institution type. For example, for every additional dollar of family income, financial aid drops by about twice as much for top private or public college attendees as compared to middle rated schools, a pattern consistent across cohorts. The composite test score or high school GPA is associated with higher aid in almost every case, and the amounts of aid are greatest at top institutions, both public and private, again consistent across cohorts.

[23] The number of slots in each sector/quality group in the student's region rather than state were used in some specifications, but this does not affect the pattern of results reported in the paper.

[24] This follows a similar approach with SAT scores used by James et al. (1989).

[25] While one must treat these reduced form estimates cautiously, there is evidence that higher family income, parental education, and measured ability are associated with a greater likelihood of attending any institution relative to a bottom public, holding other characteristics constant. For the college cost variables, one would expect that as the net costs of attending a college in the jth category rise, a student would be less likely to choose to attend an institution in the jth group relative to bottom publics. In fact, the evidence on this is mixed both within and across cohorts. The number of slots variable is generally positive and statistically significant for both cohorts as one would expect (the greater the number of slots in the jth category, the higher the probability a student will attend a college in the jth category relative to bottom publics).

The logarithm of the hourly wage rate or logarithm of annual earnings is regressed on the same set of standard explanatory variables used in Table 2, with the addition of selectivity terms associated with the systematic selection of each college type. We use these models to obtain predicted log wages or log earnings for those attending each college type and calculate the mean predicted actual wage or earnings for these students.[26] Since these models are estimated separately for each college quality type, they have the advantage of not constraining the coefficients of the control variables to be identical across college types. Wage or earnings differentials are calculated for each college quality group relative to bottom publics, which are shown in Table 3. Two estimates are presented, reflecting alternative methods of calculating the appropriate predictions, and have slightly differing interpretations (for a discussion on the use of these alternative measures see Trost and Lee (1983), and Gyuorko and Tracy (1988)). First, one can calculate *conditional* predicted log wages/earnings for each individual as given by (8):

$$\ln \hat{W}_{ji} = \hat{b}_0 + \hat{b}_{j1} X_{ji} + \hat{b}_{j2} \hat{\lambda}_{ji} \qquad j = 1 \ldots 6. \tag{8}$$

Second, one can calculate *unconditional* predicted log wages/earnings as given by (9):

$$\ln \hat{W}_{ji} = \hat{b}_0 + \hat{b}_{j1} X_{ji} \qquad j = 1 \ldots 6. \tag{9}$$

where the estimated "b"s are identical to those in (8). The unconditional measure "corresponds to an experiment in which an individual, having observable characteristics that are the same as the average [jth college type attendee], is taken at random from the population. Since we do not observe this individual's choice of sectors, the [predicted wage] reflects only the varying returns for his or her characteristics" (Gyuorko and Tracy, 1988, p. 241). On the other hand, in calculating the conditional predicted wage we know the individual's choice of sector such that the prediction reflects the varying

---

[26] This is done using the following formula:

Mean (predicted actual wage) = exp [mean predicted log wage + $0.5\sigma^2$)],

where σ^2 is the sum of squared residuals divided by the degrees of freedom obtained from each regression model.

returns to both observable and unobservable characteristics. One is not able to determine which of these measures is "best" but they may be viewed as two polar cases. The appropriateness of each "depends on whether the estimated selection effects primarily reflect differences in levels of or returns to unobserved [student] characteristics" (Gyuorko and Tracy, 1988, p. 249). We present estimates of the differential based on the conditional mean predicted wage rate/annual earnings in row (1) of Table 3 for each measure, and the differential based on the unconditional mean prediction in row (2) of Table 3.

Focusing first on the conditional estimates, the patterns found in the pooled model are replicated here. Specifically, for the 1972 cohort the premium to attending each college quality type increases with labor market experience. In general, the return to college quality increased faster in these sector-specific models relative to the pooled models. This pattern does not hold across all college quality types for the unconditional differentials, however. Similarly, the premium to college attendance increases across cohorts for recent graduates (wages about 6 years after high school graduation). The result also holds when comparing the earnings of the 1972 cohort with the 1982 cohort, but only for private schools. The unconditional results for the bottom privates and top publics should be interpreted cautiously due to small sample sizes. Comparing the selectivity corrected estimates with those of the pooled models suggest that the pattern of results is similar, although the magnitudes of the estimated rates of return vary. For example, the premium to attending an elite private college in the selectivity corrected model is larger than in the pooled model.

Finally we attempted to test the underlying structural model by using (unconditional) predicted log wages/earnings in estimates of a structural multinomial logit model of college choice. In principle, these models provide an indication of whether wages/earnings and net costs do in fact affect choice of college quality, but collinearity among the predicted wage/earnings measures for the six college quality groupings makes inferences problematic.

5. Conclusions

In this paper we have presented estimates of the effect of attending colleges of different quality on labor market outcomes. Unlike previous studies, we are able to utilize longitudinal data

which permit us to examine how the labor market return changes across time for a given cohort, and how the return changed for those cohorts who attended college in the early 1970s and the early 1980s. In addition, unlike previous attempts to determine the impact of college quality type on labor market outcomes, we allow for the fact that students systematically select the college quality type they attend on the basis of the expected labor market payoff and the net costs they face. While we find little evidence that this correction for selectivity significantly affects our results, it is important in principle. We find that there is a large premium to attending an elite private institution, and a smaller premium to attending a middle-rated private institution, relative to a bottom-rated public school. There is weaker evidence of a return to attending an elite public university. Our analysis suggests the return to elite private colleges increased significantly for the 1980s cohorts as compared to the 1972 cohort. We do not attempt to determine the *cause* of this change, but it is a potentially important finding in light of the large tuition increases concentrated at these institutions during the past two decades. These results suggest that the rising tuition at these elite private institutions was at least partially made possible by the increasing returns to quality that took place.

References

Behrman, Jere R., Mark R. Rosenzweig, and Paul Taubman (1995), "Individual Endowments, College Choice, and Wages: Estimates Using Data on Female Twins." Revised paper for NSF/RESTAT Conference on School Quality and Educational Outcomes.

Bound, John, and George Johnson, (1992), "Changes in the Structure of Wages in the 1980s: An Evaluation of Alternative Explanations." *American Economic Review* 82(3):371-92.

Brewer, Dominic J. and Ehrenberg, Ronald G. (1996), Does it Pay to Attend an Elite Private College? Evidence from the Senior High School Class of 1980, *Research in Labor Economics*, forthcoming.

Conrad, Clifton and Robert Blackburn (1985), "Program Quality in Higher Education: A Review and Critique of Literature and Research," in John Smart (ed.), *Higher Education: Handbook of Theory and Research*, Volume 1, New York: Agathon Press.

Daniel, Kermit, Dan Black and Jeffrey Smith (1995), "College Quality and the Wages of Young Men," typescript, University of Pennsylvania, June.

Ehrenberg, Ronald G. and Dominic J. Brewer (1994), "Do School and Teacher Characteristics Matter? Evidence from High School and Beyond," *Economics of Education Review*, 13(1).

Fox, Marc (1993), "Is it a Good Investment to Attend an Elite Private College?" *Economics of Education Review*, 12 (2):137-151.

Griffin, Larry and Karl Alexander (1978), "Schooling and Socioeconomic Attainments: High School and College Influences," *American Journal of Sociology*, 84 (2):319-347.

Grogger, Jeff and Eric Eide (1995), "Changes in College Skills and the Rise in the College Wage Premium," *Journal of Human Resources*, 30(2):280-310.

Gyuorko, Joseph, and Joseph Tracy (1988), "An Analysis of Public- and Private- Sector Wages Allowing for Endogenous Choices of Both Government and Union Status," *Journal of Labor Economics*, 6(2):229-253.

Heckman, James J. (1979), "Sample Selection Bias as a Specification Error," *Econometrica*, 47:153-162.

James, Estelle, Nabeel Alsalam, Joseph Conaty, and Duc-Le To (1989), "College Quality and Future Earnings: Where should you send your child to college?," *American Economic Association Papers and Proceedings*, May.

Katz, Lawrence F., and Kevin M. Murphy (1992). "Changes in Relative Wages, 1963-1987: Supply and Demand Factors." *Quarterly Journal of Economics*, 107(1):35-78.

Kingston, Paul and John Smart (1990), "The Economic Payoff to Prestigious Colleges," in Paul Kingston and Lionel S. Lewis (eds.), *The High-Status Track: Studies of Elite Private Schools and Stratification*, Albany: SUNY.

Lee, Lung Fei (1983), "Generalized Models with Selectivity," *Econometrica*, 51(2):507-513.

Levy, Frank, and Richard Murnane (1992), "U.S. Earnings Levels and Earnings Inequality: A Review of Recent Trends and Proposed Explanations," *Journal of Economic Literature*, XXX:1331-1381.

Loury, Linda Datcher and David Garman (1995), "College Selectivity and Earnings". *Journal of Labor Economics*, 13(2):289-308.

McPherson, Michael S. and Morton Owen Schapiro (1991), *Keeping College Affordable*, Washington, D.C.: The Brookings Institution.

Morgan, James N. and Greg Duncan (1979), College Quality and Earnings, in *Research in Human Capital and Development*, 1:103-121, JAI Press.

Reed, Ritchie and Herman Miller (1970), "Some Determinants of the Variation in Earnings for College Men" *Journal of Human Resources*, V(2): 177-190.

Solmon, Lewis (1973) The Definition and Impact of College Quality," in Lewis Solmon and Paul Taubman (eds.), *Does College Matter: Some Evidence on the Impacts of Higher Education*, New York: Academic Press.

Solmon, Lewis (1975), "The Definition of College Quality and its Impact on Earnings," *Exploration in Economics Research*, 2:537-587.

Solmon, Lewis and Paul Wachtel (1975), "The Effects on Income of Type of College Attended," *Sociology of Education*, 48:75-90.

Trost, Robert P. and Lung-Fei Lee (1984), "Technical Training and Earnings: A Polychotomous Choice Model With Selectivity," *Review of Economics and Statistics*, LXVI:151-156.

Wachtel, Paul (1976), The Effect on Earnings of School and College Investment Expenditures, *Review of Economics and Statistics*, 58:326-331.

Wales, Terence (1973), "The Effect of College Quality on Earnings: Results from the NBER-Thorndike Data," *Journal of Human Resources*, 8:306-317.

Weisbrod, Burton and Peter Karpoff (1968), "Monetary Returns to College Education, Student Ability, and College Quality," *Review of Economics and Statistics*, 50:491-497.

Willis, Robert J. and Sherwin Rosen (1979), "Education and Self Selection," *Journal of Political Economy*, 87: S7-S36.

Wise, David (1975), "Academic Achievement and Job Performance," *American Economic Review*, 65:350-366.

TABLE 1
Characteristics of Four-Year College Undergraduate Attendees, by College Sector and College Quality, 1972 High School Seniors and 1982 High School Seniors

	Top		Middle		Bottom	
	1972	1982	1972	1982	1972	1982
PRIVATE						
Female	.43	.45	.45	.53	.52	.53
Hispanic	0.00	.09	.01	.16	.01	.20
Black	.08	.14	.03	.13	.26	.20
Family size	2.54	3.09	2.46	3.45	2.54	3.22
Family income $	18,156	41,098	15,779	35,845	11,441	32,779
High school athlete	.58	.51	.59	.45	.52	.39
Father's education	15.59	13.51	14.48	13.44	11.43	13.42
Mother's education	14.72	15.02	13.65	13.69	12.36	13.18
Test score	7178.75	63.55	6079.80	58.46	4816.91	55.10
High school GPA	3.62	3.18	3.23	2.96	2.92	2.72
Rural high school	.09	.11	.12	.15	.17	.36
No aid	.50	.46	.57	.42	.49	.42
PUBLIC						
Female	.20	.30	.50	.51	.51	.51
Hispanic	.03	.08	.01	.14	.03	.15
Black	.12	.13	.04	.14	.15	.14
Family size	1.83	2.88	2.34	3.31	2.68	3.39
Family income $	15,471	44,103	14,805	33,876	12,119	30,590
High school athlete	.64	.50	.55	.45	.54	.44
Father's education	14.02	16.12	13.44	12.77	12.22	12.75
Mother's education	14.66	14.72	12.83	13.63	11.93	13.04
Test score	7052.28	65.02	5976.75	57.75	4984.42	55.18
High school GPA	3.56	3.46	3.20	3.02	3.10	2.93
Rural high school	.03	.03	.13	.21	.21	.35
No aid	.77	.42	.70	.55	.67	.54

NOTE: Test score, high school GPA, and high school athlete are not comparable across cohorts.

TABLE 2

Labor Market Outcomes (Relative to Bottom Publics), by College Sector and College Quality, by Cohort (absolute value t-statistics)

	1972 Cohort			1980 Cohort	1982 Cohort
	Hourly Wage Rate 1979	Hourly Wage Rate 1986	Annual Earnings 1986	Hourly Wage Rate 1986	Annual Earnings 1992
Top private	.09 (2.0)	.14 (2.8)	.15 (1.9)	.20 (4.2)	.37 (3.4)
Middle private	.04 (1.8)	.10 (3.5)	.13 (2.7)	.10 (3.6)	.08 (1.2)
Bottom private	.004 (.11)	.04 (.8)	.09 (1.2)	.01 (.)	-.16 (1.3)
Top public	-.19 (2.2)	.17 (1.5)	.22 (1.3)	.12 (1.6)	.25 (1.4)
Middle public	.05 (2.4)	.05 (2.0)	.03 (.8)	.09 (4.1)	.05 (.9)
Adjusted R^2	.09	.08	.13	.08	.07
Sample size	2959	2378	2172	2172	1786

All models include female, Hispanic, black, family size, family income, father's education, mother's education, test score, λ employment, and dummy variables indicating if the individual was in a part-time job (wage models only), or an undergraduate or graduate student at the final survey date.

Omitted category is bottom public.

TABLE 3

Predicted Wage/Earnings Differentials (Relative to Bottom Publics), by College Sector and College Quality, by Cohort

		1972 Cohort			1980 Cohort	1982 Cohort
		Hourly Wage Rate 1979	Hourly Wage Rate 1986	Annual Earnings 1986	Hourly Wage Rate 1986	Annual Earnings 1992
Top privates	(1)	15.7	26.7	36.7	37.4	45.0
	(2)	7.2	17.1	26.1	36.8	47.8
Middle privates	(1)	5.5	16.7	17.4	14.9	18.1
	(2)	-2.3	25.0	9.3	31.8	47.2
Bottom privates	(1)	-1.2	2.3	-4.7	5.5	-3.6
	(2)	-7.9	-9.3	-32.0	78.7	59.8
Top publics	(1)	-11.7	18.7	19.5	23.1	9.7
	(2)	11.7	-10.0	-33.7	27.3	-54.4
Middle publics	(1)	6.4	9.7	8.5	15.5	6.8
	(2)	11.8	15.1	4.7	34.4	11.0

(1) Differential based on conditional predicted wages/earnings.

(2) Differential based on unconditional predicted wages/earnings.

Differentials are for college group shown relative to bottom publics.

APPENDIX TABLE 1
Sample Characteristics of College Attendees, means (standard deviations)

1972 Cohort

	PRIVATE			PUBLIC		
	Top	Middle	Bottom	Top	Middle	Bottom
Female	.43	.50	.57	.18	.53	.53
Hispanic	.00	.01	.02	.05	.02	.04
Black	.09	.04	.30	.14	.05	.16
Family size	2.6 (1.5)	2.4 (1.5)	2.6 (1.6)	1.8 (.94)	2.4 (1.4)	2.6 (1.6)
Family income $	18,127 (7268)	15,570 (7273)	11,105 (6868)	16,474 (7536)	14,551 (6949)	12,182 (7174)
High school athlete	.60	.58	.50	.68	.54	.54
Father's education	15.63 (4.6)	14.30 (4.5)	11.42 (5.7)	14.80 (5.0)	13.48 (4.70)	11.97 (5.3)
Mother's education	14.67 (2.9)	13.38 (3.3)	12.34 (3.8)	14.60 (2.5)	12.86 (3.5)	11.78 (4.4)
Test score	7194 (876)	6043 (1289)	4885 (1595)	6978 (843)	6034 (1257)	5080 (1599)
High school GPA	3.62 (.4)	3.24 (.6)	3.01 (.6)	3.57 (.3)	3.23 (.5)	3.14 (.6)
Rural high school	.08	.13	.18	.05	.14	.25
Urban high school	.30	.23	.36	.14	.28	.29
Public high school	.88	.80	.92	.95	.90	.90
Financial aid	1000 (2015)	492 (1163)	494 (981)	311 (1370)	212 (695)	226 (688)
Sample size	127	678	155	22	1416	664

1982 Cohort

	PRIVATE			PUBLIC		
	Top	Middle	Bottom	Top	Middle	Bottom
Female	.45	.54	.56	.34	.51	.53
Hispanic	.09	.17	.21	.09	.15	.16
Black	.13	.12	.19	.11	.12	.14
Family size	3.13 (1.4)	3.41 (1.6)	3.08 (.5)	2.91 (1.4)	3.30 (1.5)	3.41 (1.6)
Family income $	41,509 (22,693)	36,095 (19,101)	31,986 (19346)	45,091 (20,950)	34,061 (18,727)	29,955 (17,790)
High school athlete	.48	.45	.40	.49	.46	.45
Father's education	14.15 (6.8)	13.45 (5.4)	13.21 (5.1)	15.88 (5.7)	12.88 (5.8)	12.50 (5.2)
Mother's education	15.04 (3.3)	13.58 (3.4)	13.14 (2.9)	14.61 (4.0)	13.58 (3.1)	12.97 (3.2)
Test score	63.73 (4.5)	58.18 (6.5)	54.67 (7.1)	64.80 (4.2)	57.91 (6.9)	54.78 (7.2)
High school GPA	3.20 (.5)	2.96 (.6)	2.72 (.6)	3.46 (.4)	3.03 (.6)	2.93 (.6)
Rural high school	.10	.15	.34	.03	.22	.37
Urban high school	.22	.20	.15	.11	.19	.21
Public high school	.47	.45	.68	.51	.71	.79
Financial aid	2792 (3260)	1594 (2215)	1036 (1377)	1499 (2076)	760 (1364)	584 (1053)
Sample size	127	494	80	35	954	475