

# The Economic Returns to College Major, Quality and Performance: A Multilevel Analysis of Recent Graduates

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**Abstract** — This paper estimates the impact of three types of qualitative differences in college experiences on the earnings of recent college graduates — college major, school quality and educational performance. The analysis is based on a new statistical technique, known as hierarchical linear modeling (HLM), which distinguishes more precisely between the effects of individual factors and institutional factors on earnings. The results show that all three types of qualitative factors influence initial earnings, but the effects of institutional quality and educational performance are not uniform for graduates with different college majors.

## I. INTRODUCTION

A SUBSTANTIAL BODY of research conducted over the last 30 years has demonstrated sizeable economic benefits from college participation. College graduates earn substantially more than high school graduates and these differences have increased markedly in recent years (Murphy and Welch, 1989). A more limited body of research has further demonstrated that there are also important qualitative differences in the economic returns to college. Three sources of qualitative differences have been identified in previous research: (1) those due to differences in the choice of college major, (2) those due to differences in the quality of the institution attended, and (3) those due to differences in college performance.

It has long been recognized that the earnings of college graduates are effected substantially by their choice of college major. In general, college graduates who major in engineering and business tend to command higher salaries than students who major in other disciplines (Rumberger, 1984; Berger, 1988a,b; James *et al.*, 1989). Moreover, these

differences tend to increase over time (Berger, 1988a,b). Because these differences are well-known, they influence the choices that students make when deciding what major to select in college (Freeman, 1976; Berger, 1988a). For example, the continued high salaries enjoyed by engineering graduates have greatly expanded enrollments in engineering programs (U.S. NCES, 1991, Table 225).

A second source of qualitative differences concerns institutional quality. Graduates from higher quality institutions, where quality is most frequently measured by a single index of institutional "selectivity" (the Astin index of the average SAT/ACT scores of freshmen), generally enjoy higher salaries than graduates from lower quality institutions, even controlling for differences in family background and ability (e.g. Solmon, 1973, 1975; Trusheim and Crouse, 1981; Smart, 1988; Mueller, 1988; James *et al.*, 1989). However, in most cases the effects explain only a small proportion of the variance in earnings. In addition, it appears that the effects are stronger from students from higher social class backgrounds than from lower ones (Karabel and McClelland, 1987).

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A third source of qualitative differences concerns college performance. Several studies have demonstrated that college grades significantly affect graduates' salaries as well as salary increases, even controlling for differences in college major and college quality (Wise, 1975; James *et al.*, 1989; Jones and Jackson, 1990). For example, one recent study estimated that a one point increase in the college grade point average was associated with a 9% salary increment for graduates almost 10 years after leaving school (James *et al.*, 1989, Table 1).

Although the existing research literature has successfully demonstrated that qualitative differences in graduates' experiences in college have important influences on earnings, it suffers from several limitations. First, much of this literature focuses on graduates from the 1970s, 1960s, and even earlier and thus does not reveal whether these differences continue to exist for more recent graduates. Second, most of this research focuses only on males and often only white males, thus ignoring important gender and racial differences in the economic impact of college quality. Third, most of the existing literature uses very limited models to estimate the effects of college quality, which could lead to incomplete conclusions. For example, some studies only use a single measure of institutional quality (e.g. Wise, 1975; Karabel and McClelland, 1987), while other studies ignore the effects of college major (e.g. Mueller, 1988; Karabel and McClelland, 1987). Finally, many studies use data drawn from nested samples of students attending the same institution, which can lead to inefficient estimates due to interdependent observations (Raudenbush, 1988).

The present study attempts to address each of these limitations. First, it uses data on recent college graduates. Second, it examines gender and racial differences in the economic returns to college. Third, it uses a robust model to estimate the economic returns to college that includes various dimensions of institutional quality, college major and college grades. Finally, it uses a new statistical technique to properly estimate the effects of institutional characteristics on nested samples of students.

The study addresses the following research questions:

1. What are the effects of college major, quality and performance on the earnings of recent college graduates?
2. How do these effects differ between men and women, whites and non-whites?
3. What are the effects of different measures of college quality on the earnings of college graduates with the same college major?

## II. METHODOLOGY

### Data and Samples

Two types of data were required to carry out this study: data on individual college graduates and data on the colleges where they received their degrees. The individual data came from the 1987 Survey of Recent College Graduates (RCG). The 1987 RCG is one in a series of periodic national surveys of recent college graduates administered by the U.S. Department of Education. The 1987 survey was administered to 22 400 college graduates (75% return rate,  $N = 16\,878$ ) who received either a bachelor's ( $N = 15\,082$ ) or a master's ( $N = 1796$ ) degree between 5 July 1985 and 30 June 1986. These graduates were selected from 404 institutions in the continental United States that were chosen from the 1983–1984 Survey of Earned Degrees (HEGIS XIX). The graduates were then sampled from lists supplied by the participating schools. Black and Hispanic students as well as those in the field of education were over-sampled.

Since the economic benefits of college quality may differ between graduate and undergraduate degree holders, we limited the present study to graduates with bachelor's degrees ( $N = 15\,082$ ). From this original sample, we excluded individuals who: (1) were missing school-level data ( $N = 4143$ ); (2) were not working and hence had no earnings ( $N = 1439$ ); and (3) were enrolled in school ( $N = 1456$ ). We imposed the latter condition in order to exclude persons who might be working in non-career occupations while attending school. The final sample size was 8021 individuals.<sup>1</sup>

The school-level data for this study were drawn from the Annual Survey of Colleges (ASC) data for 1985–1986. This data base, compiled by the College Board, is comprised of information on programs, requirements and characteristics of postsecondary institutions in the United States. These data were supplemented with Astin's institutional selectivity ratings (Astin and Henson, 1977), which were updated in 1983.

The sample of schools used in the study were initially selected from graduates meeting the second

and third inclusion requirements discussed above. From this initial sample, schools with missing school-level data were dropped from the sample and their students removed from the individual-level data. Upon conclusion of this process there were a total 262 schools remaining.

### **Variables**

A variety of both individual-level and school-level variables were used in this study. Their names, means and standard deviations for the two overall samples, and a brief description are shown in Table 1.

**Individual-level variables.** The individual-level variables consist of four types: demographic, family background, education and labor market. The demographic variables consisted of dummy variables for females (FEMALE), Hispanics (HISPANIC) and blacks (BLACK), since each of these groups generally have different labor market experiences than white males.

The family background variables included measures of father's and mother's education (PAEDUC, MAEDUC), and a series of dummy variables indicating whether their father or mother were employed in either a professional occupation (PAPROF, MAPROF) or a managerial occupation (PAMANGR, MAMANGR).

The education variables consisted of two areas of interest: college major and college performance. College degrees were grouped into seven major areas and coded as a series of dummy variables for the first part of the analysis: engineering (ENGINEER), business (BUSINESS), health (HEALTH), education (EDUCATE), social sciences (SOCSCI), mathematics and science (SCI/MATH), and a residual category which primarily consisted of humanities areas. College performance was measured by self-reported college grade point average (GPA), which was coded on a 0–4 scale.

Labor market variables included the amount of time between the survey data (27 April 1987) and college graduation (TIMEOUT), years of labor market experience (YRSEXP, imputed with the formula  $\text{age} - 22$ ), the number of hours worked per week (NUMHRS), and dummy variables representing public sector employment (PUBLIC) or self-employment (SELFEMPL). Two additional variables indicated whether graduates were employed in a job where they felt a degree was not

required (DEGNOTRQ) or whether they were employed in a job not related to their area of college degree (JOBNOTRL).

**School-level variables.** The school-level variables covered a wide range of characteristics of colleges and universities that reflect the quality of the institutions, the educational experiences of their students, and the labor market experiences of their graduates. First, we included a dummy variable to indicate private schools (PRIVATE). Second, we included a number of variables indicating the social composition of the students: Astin's selectivity score, which represents the average SAT scores of entering freshmen (SELECT), the percentage of minority undergraduates (PCTMINUG), and the mean educational level of students' fathers, computed for each school from the mean values of the entire RCG student sample (PAEDUCM). Third, we included two measures of attractiveness and exclusiveness: the total number of applications divided by the number of students (ATTRACT) and the percentage of all applications accepted (PCTACPT). Fourth, we included a number of measures of resources: the percentage of faculties holding full-time (as opposed to part-time) positions (PCTFACTFT), the percentage of faculties with PhDs (PCTFCPHD), and the student/faculty ratio (SFRATIO). Finally, we included several other measures that could reflect the orientation and atmosphere of the school: the proportion of undergraduates attending full-time (PCTUGFT), the proportion of all students who are undergraduates (PCTUG), and the total number of students (STDBY100).

Of course, many of these measures are related, as has been shown previously (e.g. Astin and Henson, 1977). The correlations for all the school-level measures are shown in Appendix A.

### **Descriptive Differences by College Major**

College graduates differ widely both in their choice of college major and in the earnings associated with that choice. These differences, broken down by gender, are illustrated in Tables 2 and 3.<sup>2</sup>

The data reveal that large differences in the choice of college major occur between males and females. More than half of all females major in the traditionally female areas of health and education, whereas only about 13% of males choose majors in these fields. In contrast, males are much more likely

**Table 1.** Variable descriptions and descriptive statistics for individual- and school-level data

Name	Mean	S.D.	Description
<b>I. Individual-level data (<i>N</i> = 8021)</b>			
<b>Demographic</b>			
Female	0.63		Dummy coded 1 = female 0 = male
Hispanic	0.03		Dummy coded 1 = Hispanic 0 = other
Black	0.04		Dummy coded 1 = black 0 = non-black
<b>Family background</b>			
PAEDUC	14.08	2.37	Years of father's education (converted to years from "highest level of father's education")
MAEDUC	13.39	1.93	Years of mother's education (converted to years from "highest level of mother's education")
PAPROF	0.29		Father professional — dummy coded 1 = yes 0 = no
MAPROF	0.09		Mother professional — dummy coded 1 = yes 0 = no
PAMANGR	0.20		Father manager — dummy coded 1 = yes 0 = no
MAMANGR	0.20		Mother manager — dummy coded 1 = yes 0 = no
<b>Education</b>			
ENGINEER	0.06		Engineering major (engineering and related technologies) — dummy coded 1 = yes 0 = no
BUSINESS	0.18		Business major (business and management/administrative support/marketing) — dummy coded 1 = yes 0 = no
HEALTH	0.25		Health major (allied health and health sciences) — dummy coded 1 = yes 0 = no
EDUCATE	0.15		Education major — dummy coded 1 = yes 0 = no
SCI/MATH	0.14		Science/mathematics major (communications technologies/computer and information/science/life science/mathematics/physical science/science technologies — dummy coded 1 = yes 0 = no
SOCSOI	0.09		Social science major (communications/psychology/social sciences) — dummy coded 1 = yes 0 = no
GPA	3.16	0.48	Grade point average (conversion of self-reported grades to 0–4 point scale)
<b>Labor market</b>			
TIMEOUT	1.07	0.28	Time since graduation (27 April, 1987 — graduation date)
YRSEXP	4.22	5.50	Years of experience (age – 22)
NUMHRS	39.93	8.22	Number of hours worked per week
PUBLIC	0.25		Work in public sector — dummy coded 1 = true 0 = false
SELFEMPL	0.01		Self-employed — dummy coded 1 = true 0 = false
DEGNOTRQ	0.37		Degree not required for job — dummy coded 1 = true 0 = false
JOBNOTRL	0.40		Job not related to field of major — dummy coded 1 = true 0 = false
<b>II. School-level data (<i>N</i> = 262)</b>			
PRIVATE	0.37		School sector — dummy coded 1 = private 0 = public
SELECT	961.62	128.17	Astin's selectivity score
PCTMINUG	15.41	18.20	Percentage of minority undergraduates
PAEDUCM	14.09	17.03	Average level of father's education (aggregated from all undergraduates in RCG file)
ATTRACT	55.74	31.46	Attractiveness measure (applications/total size)
PCTACPT	73.90	16.46	Percentage of applications accepted
PCTFACFT	76.69	16.98	Percentage of faculty holding full-time positions
PCTFCPHD	45.52	26.46	Percentage of faculty holding PhD
SFRATIO	12.28	4.28	Student faculty ratio
STDBY100	100.69	81.23	Total number of students/100
PCTUGFT	93.68	7.65	Percentage of undergraduates attending full-time
PCTUG	86.76	11.65	Percentage of undergraduates in student body (total students/undergraduates)

Sources: All individual-level variables come from the 1987 Survey of Recent College Graduates. All school level variables, with the exception of SELECT and PAEDUCM, come from The College Board's 1986 Annual Survey of Colleges. The variable SELECT comes from Alexander Astin's (1983) college selectivity ratings. PAEDUCM was aggregated from the entire RCG sample.

**Table 2.** College major of employed 1985–1986 bachelor's degree recipients by gender

Major	Males (%)	Females (%)
Engineering	13.6	1.5
Business	25.1	13.8
Health	4.6	36.5
Education	8.9	18.4
Science/mathematics	22.6	8.8
Social Science	12.5	7.6
Other	12.7	13.4
Total	100.0	100.0
N	2951	4999

**Table 3.** 1987 mean annual earnings of employed 1985–1986 bachelor's degree recipients by gender

Major	Males (\$)	Females (\$)
Engineering	25,782	25,222
Business	21,460	18,856
Health	23,653	21,735
Education	16,851	13,824
Science/Mathematics	21,940	19,585
Social Science	18,523	16,271
Other	17,761	14,552
Total	21,008	18,362

Source: 1987 Survey of Recent College Graduates.

to major in engineering (14%), business (25%) or science/math (23%).

Initial earnings of college graduates vary widely by college major. Engineering graduates earn the highest salaries of any college major for both men and women. Male engineering graduates earn almost \$5000 or 24% more per year than the average male graduate, while female engineering graduates earn almost \$7000 or 39% more than the average female graduate. Health majors receive the next highest salaries for both men and women: about \$2600 or 12% more for males and about \$3400 or 19% more for females.

In general, earnings vary more widely by college major for females than for males. And except for engineering, women earn about 10% less than men in every group of college majors.

### Models

In order to examine the impact of college quality on earnings, two types of models and estimation procedures were employed in this study. The first involved estimating individual earnings using ordi-

nary least-squares (OLS) regression, the most common approach for estimating earnings equations. OLS regression techniques are appropriate for estimating the unique contributions of a large array of individual-level characteristics on individual outcomes.

Individual-level models and OLS techniques are inappropriate, however, when the available data are nested within larger institutional units, as in this study. The RCG data used in this study are based on nested samples of students selected within colleges. Thus, the individual observations are not independent which can result in misestimated standard errors using OLS techniques (Raudenbush, 1988). Apart from the methodological problem, OLS techniques do not provide a convenient means to test explicit models at two levels of interest: student-level models that operate within institutional units and school-level models that examine whether the student-level models vary systematically *between* institutional units. The second technique used in this study, referred to as hierarchical linear modeling (HLM), was developed specifically to model within- and between-school phenomena.

One limitation of HLM models is that the number of variables used in the individual-level models is constrained by the number of observations within institutional units, which in most available surveys is quite small. Since this is the case with the RCG data used in this study, we employed OLS techniques to get a more robust picture of the individual influences on earnings and then used HLM techniques to get a more robust picture of institutional influences on earnings.

**OLS models.** In our first set of analyses we used an OLS earnings function model to estimate annual income, introducing variables capturing demographic, family background, school and labor market characteristics. The basic model was:

$$\ln Y_i = a + B_1X_1 + B_2X_2 + B_3X_3 + B_4X_4 + E_i \quad (1)$$

where  $Y$  is income,  $X_1$  is a vector of demographic variables,  $X_2$  is a vector of family background variables,  $X_3$  is a vector of school variables, and  $X_4$  a vector of labor market variables.

**HLM models.** HLM techniques first involve estimating an individual-level model *within* each

school and then estimating a series of *between* school models using the estimated within-school parameters ( $B$  coefficients) as dependent variables. Since earnings of college graduates vary widely by college major, as shown above, we decided to estimate earnings for each group of college majors separately.

There are three steps in this type of analysis. First, the variance in earnings is partitioned within and between schools. This is accomplished by fitting a within-school model where only a random mean earnings coefficient is specified:

$$\ln Y_{ij} = B_{j0} + E_{ij} \quad (2a)$$

where  $Y_{ij}$  is the annual earnings for individual  $i$  in school  $j$ ,  $B_{j0}$  is the mean earnings for school  $j$ , and  $E_{ij}$  is the deviation from the school mean for individual  $i$ . The unconditional between-school model is specified as:

$$B_{j0} = u + U_j \quad (2b)$$

where  $B_{j0}$  is the school mean,  $u$  is the grand mean, and  $U_j$  is the deviation from the grand mean for school  $j$ . This step is used to partition the total variance in log earnings into its within- and between-schools components.

Second, an unconditional, within-school model is specified that attempts to explain earnings differences based on individual variables within each school. Using the results of the OLS estimates, we specified the following within-school model:

$$Y_{ij} = B_{0j} + B_{1j}(\text{FEMALE}) + B_{2j}(\text{GPA}) + B_{3j}(\text{JOBNOTRI}) + E_{ij} \quad (3a)$$

where  $B_{0j}$  is the mean earnings for students graduating from school  $j$ ,  $B_{1j}$  is the earnings differential received by female graduates compared to male graduates from school  $j$ ,  $B_{2j}$  is the earnings increment associated with a unit change in GPA, and  $B_{3j}$  is the earnings differential for individuals who were employed in a job that they felt was not related to their major. The regression coefficients indicate the effects of student characteristics on earnings within each school.

A distinctive feature of HLM analysis is that the regression coefficients for the individual model are allowed to vary across schools. For each  $B$  co-

efficient in the within-school model, the between-school equation in the unconditional model is:

$$B_{jk} = u_k + U_{jk} \text{ for } k = 0,1,2,3,4 \quad (3b)$$

where  $B_{jk}$  represents one of the within-unit regression parameters from equation (3a) and  $u_k$  is the mean value for each of the within-unit parameters. This model is useful in estimating the total parameter variance in the intercepts and regression slopes and to test whether there is homogeneity in the random effects across schools. If the homogeneity hypothesis for a student-level variable is sustained, indicating no significant difference across schools in the effect of that variable on earnings, then one can specify a common or fixed regression slope for that parameter for all schools in subsequent analyses.

The final step in the HLM analysis is to create a "conditional model" using school-level variables to explain differences in those regression coefficients that vary significantly across schools. Since the estimated values of the individual predictors turned out to be either insignificant or unreliable, we fixed them in cases where they were homogeneous or we allowed them to vary randomly across schools without modeling them. We then specified two conditional models to estimate between-school differences in the base coefficients. In the first, we attempted to explain between-school differences based only on school "selectivity", the variable for school quality used in most previous studies and in the OLS estimates. The first conditional model was:

$$B_{j0} = I_{00} + I_{10}\text{SELECT}_{1j} + U_{j0} \quad (3c)$$

where  $B_{j0}$  represents a within-unit regression parameter for the intercept term from equation (3a) and  $I_{10}$  is the estimated parameter for the effect of selectivity on average between-school values for log earnings.

In the second conditional model, we expanded the number of explanatory variables in the between-school equations. The second model was:

$$B_{j0} = I_{00} + I_{10}Z_{1j} + \dots + I_{n0}Z_{nj} + U_{j0} \quad (3d)$$

where  $B_{j0}$  represents the within-unit intercept term from equation (3a),  $Z_{nj}$  are a series of school-level variables and  $I_{0n}$  are the estimated parameters for the school-level variables.

### III. RESULTS

#### Regression Models

The individual model was estimated for several samples of students. The model was first estimated on the overall sample with dummy variables included for female, Hispanic and black. The model was estimated in two steps, first excluding labor market variables and then including labor market variables. The latter model was then estimated separately for males and females with dummy variables for Hispanic and black in order to test for differential effects of all the independent variables. A fifth group which included Asians, Pacific Islanders and American Indians was not analyzed because it was small and heterogeneous and thus

could not reveal anything about the specific ethnic groups.

The regression coefficients for these groups are displayed in Table 4. The results indicate that a number of demographic, college and labor market variables had significant effects on earnings, but no family background variables were significant.

**Demographic variables.** In the overall sample (columns 1 and 2), the regression estimates reveal significant differences in the starting salaries for females compared with males. The results show that the starting salaries of female college graduates are about 13% lower than males after controlling for a variety of college and family background factors and about 5% lower after also controlling for labor

Table 4. OLS regression coefficients of log annual earnings

Variables	All	All	Males	Females
Demographic				
Female	-0.1300†	-0.0532†		
Hispanic	0.0732 <sup>^</sup>	0.0438	-0.0128	0.0735 <sup>^</sup>
Black	0.0167	0.0241	-0.0168	0.0356
Family background				
Father's education	0.0001	0.0007	-0.0043	0.0036
Mother's education	-0.0075†	-0.0031	-0.0063	-0.0001
Father professional	0.0222	0.0190	0.0373*	0.0111
Mother professional	-0.0061	-0.0228	-0.0101	-0.0299
Father manager	-0.0258	-0.0154	-0.0059	-0.0230
Mother manager	0.0153	-0.0091	-0.0001	-0.0149
College				
Engineering major	0.4925†	0.3869†	0.3194†	0.4781†
Business major	0.2917†	0.1786†	0.1120†	0.2167†
Health major	0.4474†	0.3679†	0.2265†	0.4079†
Education major	-0.0066	-0.0550†	-0.0719*	-0.0354
Science/mathematics major	0.3062†	0.2441†	0.1833†	0.2682†
Social science major	0.0997†	0.0606†	0.0046	0.0901
GPA	0.0619†	0.0340†	0.0044	0.0511†
Private college	0.0075	0.0160	0.0378*	0.0059
Selectivity index	0.0004†	0.0004†	0.0003†	0.0004†
Labor market				
Time out of school		0.0798†	0.0873†	0.0698†
Years of experience		0.0123†	0.0219†	0.0101†
Hours worked per week		0.0271†	0.0213†	0.0316†
Public sector		-0.0416†	-1.1222†	-0.0076
Self-employed		-0.0358	0.0081	-0.0539
Degree not required		-0.1582†	-0.2165†	-0.1279†
Job not related		-0.0876†	-0.0823†	-0.0817†
Constant	9.054	8.057	8.6009	7.6392
Adjusted R <sup>2</sup>	0.1779	0.4375	0.3510	0.4998
N	7235	7235	2716	4519

<sup>^</sup>Significant at  $P = 0.05$ ; †significant at  $P = 0.01$ .

OLS = Ordinary least-squares.

GPA = Grade point average.

market factors. This suggests that part of the lower pay received by female college graduates has to do with the type of job they receive. In particular, the data reveal that females are more likely to get a job where they report a degree is not required or is not related to their degree.

The results reveal no earnings disadvantage for minority college graduates. In fact, Hispanic females earn 7% more than white or black female graduates after controlling for other factors. These findings do not support existing research which shows widespread earnings differences among race and ethnic groups (e.g. Gwartney and Long, 1978; Tienda and Lii, 1987; Meisenheimer, 1990), but most existing studies have looked at all education groups together, not just college graduates. Earnings differences between college graduates, in general, are smaller than other education groups and have improved markedly in recent years (Smith and Welch, 1989, Table 2). One other study that did look only at college graduates also found no earnings differential between whites and non-whites (Berger, 1988).

The present findings can probably be attributed to three factors: (1) the small number of minorities in the sample, which reflects the small number of minorities who attend and ultimately graduate from college;<sup>3</sup> (2) the current period in which many firms are actively recruiting minority college graduates of which they are few; and (3) the fact that we are focusing only on starting salaries which may not reveal subsequent disadvantages that minority college graduates could face in the future.

**Family background variables.** Family background variables did not influence starting salaries. Other studies have found that family background tends to have a greater impact on how much schooling individuals receive and even on the kind of school they attend than on earnings of college graduates, although there may be a more direct impact on wealth (e.g. Karabel and Astin, 1975; Rumberger, 1983; Hearn, 1984).

**College variables.** The results show that all three types of qualitative measures — college major, college quality and college performance — significantly affect the starting salaries of most college graduates.

First, there are substantial differences in starting salaries for college graduates with different college

majors after controlling for a variety of demographic, labor market and family background variables. Engineering and health majors received starting salaries about one-third higher than graduates in the humanities (the left-out group), while business and science/math majors were about 20% higher. Controlling for labor market variables mitigated some of these effects, suggesting that college majors have access to different labor markets which influences earnings. These findings are consistent with other studies that have examined differences in the initial and subsequent earnings of college graduates with different majors (Griffin and Alexander, 1978; Rumberger, 1984; Berger, 1988a; James *et al.*, 1989).<sup>4</sup> Of course, earnings differences do not take into account non-monetary compensation, which could also be effected by college major (Mathios, 1989).

The relative differences among majors varied for males and females. For example, business majors commanded salaries 22% higher than humanities graduates among women, but only 11% higher among men. For both groups, engineering graduates commanded the highest salaries, although for females the differential was only 7% higher than the one received by health majors. A recent study of black college graduates in one company found that engineering graduates received higher starting salaries than graduates with other degrees, although business majors enjoyed larger salary growth rates than other majors (Solnick, 1990). Finally, social science and education majors enjoyed no significant earnings advantage over humanities majors. In fact, male education majors earned 7% less than these other groups.

The two college quality measures used in this part of the analysis suggest that males receive an earnings advantage for attending a private school, but females do not. Both males and females receive an earnings advantage for attending more selective schools; males receive a 3% premium for each 100 point increase in college selectivity, females receive a 4% premium. This finding is also consistent with both recent and earlier studies that have examined the impact of selectivity on earnings (Wales, 1973; Wise, 1975; James *et al.*, 1989), although one recent study found that the premium was higher for students from professional and managerial families than for students from blue-collar backgrounds (Karabel and McClelland, 1987).

The final qualitative measure — college GPA —

showed a significant impact on starting salaries for the overall sample and for females, but not for males. A one-point increase in college GPA raised starting salaries by 5% for women. Other studies that have examined the impact of college GPA have generally found a positive impact on earnings for males as well as for blacks (e.g. Wise, 1975; James *et al.*, 1989; Solnick, 1990; Jones and Jackson, 1990). The current findings suggest that recent college graduates may not enjoy the same payoffs to higher grades that graduates enjoyed in the past.

**Labor market variables.** A number of labor market variables show significant influences on starting salaries for college graduates. Graduates who have been out of school longer, have more years of imputed labor market experience (i.e. are older), and work longer hours in the week have higher salaries than other graduates. These variables have similar effects on the salaries of males and females. But males who were employed in the public sector had salaries 12% lower than other male graduates, whereas females were not penalized for working in the public sector. Finally, most graduates who were employed in jobs either unrelated to their college major or in jobs where a college degree was not required (in their opinion), earned substantially less than other college graduates. The penalty for holding a job not related to one's major (JOBNOTRL) was 22% for males and 13% for females. This result is consistent with studies of vocational high school graduates where students receive a wage premium for holding jobs related to their area of vocational training (Bishop, 1989).

Holding a job where a college degree is not required (DEGNOTRQ) reduced earnings by 8% for females, but had no significant effect on the salaries of males. This last finding is consistent with a number of other studies that have found workers with more education than their jobs required, which is commonly referred to as overeducation or surplus schooling, receive a lower return on investment in an extra year of schooling than other workers (e.g. Rumberger, 1987; Tsang, 1987; Hartog and Oosterbeek, 1988).

Overall, the regression results are consistent with previous studies that have found all three aspects of educational quality — college major, college quality and college grades — affect the earnings of college graduates.

### Hierarchical Models

In order to conduct the HLM analysis, the total sample was divided into sub-samples of graduates with the same college major. Thus one of the most powerful predictors of initial earnings for college graduates — college major — is taken into account. The HLM analysis analyzes what other factors, both individual and institutional, affect the initial salaries of college graduates with the same college major. Six sub-samples of graduates were analyzed separately within the HLM framework: engineering, business, health, education, social science and science/mathematics. Because graduates with different majors can come from different schools, the number and specific schools associated with each group of college majors differs.<sup>5</sup>

**The unconditional HLM model.** The first step in performing the HLM analysis was to partition the total variance in each sub-sample into its within-school and between-school components based on equations (2a) and (2b). The results of this procedure, shown in the top part of Table 5, show that most of the variance in annual earnings occurs within schools. The estimated parameter variance between schools ranges from 0.001 for engineering majors to 0.02 for social science majors, which represents between 1 and 9% of the total variance in log earnings.<sup>6</sup> Although these estimates appear small, they translate into a standard deviation of between 0.044 and 0.14, which suggests that average earnings could vary between schools by as much as 8–28% from the mean (two times a standard deviation). These are the differences that the HLM models attempt to explain.

The next step in the HLM analysis involved estimating an unconditional model based on equations (3a) and (3b). In this model, the effects of the independent variables (FEMALE, GPA, JOBNOTRL) are assumed to vary randomly among schools. Each independent variable is also centered at its school mean, so that the mean value of the dependent, within-school variable (LNEARN) represents the mean log earnings for all graduates in that school. Estimated values and their significance levels for the individual-level model averaged across all the schools within each of the six sub-groups are displayed in the top part of Table 6.

The results show large mean earnings differences among the six college majors as was found both in the descriptive statistics and OLS estimates reported

Table 5. Variance within- and between-schools and proportion of variance explained by models

	Engineering		Business		Health		Education		Social science		Science/mathematics	
	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)
Within-school variance	0.1538		0.1667		0.1237		0.2342		0.2130		0.2492	
Between-school variance	0.0011		0.0166		0.0074		0.0152		0.0201		0.0187	
Proportion of total	0.0074		0.0906		0.0564		0.0608		0.0864		0.0696	
	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)	Var ( $\beta_w$ )	R <sup>2</sup> (%)
Mean earnings												
Unconditional model	0.0036		0.0199		0.0083		0.0164		0.0221		0.0258	
Conditional model 1	0.0012	(17.1)	0.0163	(18.1)	0.0080	(3.6)	0.0155	(5.5)	0.0165	(25.3)	0.0214	(17.1)
Conditional model 2	0.0062	(—)	0.0115	(42.2)	0.0043	(48.2)	0.0002	(98.8)	0.0076	(65.6)	0.0119	(53.9)
Female												
Unconditional model	0.0190		0.0131		0.0303		0.0109		0.0131		0.0298	
Conditional model 1	—		—		0.0303	(—)	—		—		0.0263	(11.7)
Conditional model 2	—		—		0.0330	(—)	—		—		0.0275	(7.7)
GPA												
Unconditional model	0.0312		0.0123		0.0069		0.0277		0.0249		0.0091	
Conditional model 1	—		—		—		—		—		—	
Conditional model 2	—		—		—		—		—		—	
Unrelated												
Unconditional model	0.0352		0.0098		0.1867		0.0127		0.0239		0.0436	
Conditional model 1	—		—		0.1892	(—)	—		—		0.0424	(2.8)
Conditional model 2	—		—		0.1906	(—)	—		—		0.0391	(10.3)
Total no. schools	36		146		130		71		38		85	

Var = Variance; GPA = grade point average.

Table 6. HLM estimates of unconditional model by college major

	Engineering	Business	Health	Education	Social science	Science/mathematics
<b>Earnings</b>						
Mean	10.1058**	9.8313**	9.9391**	9.4767**	9.6770**	9.8387**
(Reliability)	(0.1690)	(0.5120)	(0.5150)	(0.3960)	(0.4180)	(0.4710)
<b>Female</b>						
Mean	-0.0373	-0.1776**	-0.0539	-0.2203**	-0.0823	-0.1103**
(Reliability)	(0.0970)	(0.0550)	(0.2010)	(0.0320)	(0.0320)	(0.0910)
<b>GPA</b>						
Mean	0.0783	0.0960**	0.0239	0.0996**	-0.0423	0.0882*
(Reliability)	(0.1490)	(0.0440)	(0.0660)	(0.0620)	(0.0340)	(0.0200)
<b>Unrelated</b>						
Mean	-0.1830**	-0.1337**	-0.3123**	-0.1531	0.0576	-0.3066**
(Reliability)	(0.2150)	(0.0350)	(0.6320)	(0.0440)	(0.0690)	(0.1400)
<b>Chi-square table†</b>						
<b>Earnings</b>						
Est variance	0.0036	0.0199	0.0083	0.0164	0.0221	0.0258
DF	24	130	49	70	37	84
Chi-square	32.0870	288.7000	158.2300	132.5800	62.0830	166.3100
P value	0.1250	0.0000	0.0000	0.0000	0.0060	0.0000
<b>Female</b>						
Est variance	0.0190	0.0131	0.0303	0.0109	0.0131	0.0289
DF	24	130	49	70	37	84
Chi-square	22.4410	150.2100	79.8660	66.1070	44.9080	121.0600
P value	>0.5000	0.1090	0.0040	>0.5000	0.1740	0.0030
<b>GPA</b>						
Est variance	0.0312	0.0123	0.0069	0.0277	0.0249	0.0091
DF	24	130	49	70	37	84
Chi-square	24.3670	133.3200	57.1000	77.5160	49.4200	89.1700
P value	0.4410	0.4030	0.1990	0.2510	0.0830	0.3290
<b>Unrelated</b>						
Est variance	0.0352	0.0098	0.1867	0.0127	0.0239	0.0436
DF	24	130	49	70	37	84
Chi-square	24.9190	125.2600	193.6800	77.5160	28.4570	166.3900
P value	0.4100	>0.5000	0.0000	0.3040	>0.5000	0.0000

†The chi-square statistics are based on those schools that have sufficient data for computation. Additionally, these statistics are derived from univariate tests and do not take random effects in the model into account. These statistics should be treated as approximations.

\*\* Significant at the 0.01 level.

\* Significant at the 0.05 level.

HLM = Hierarchical linear modeling.

GPA = Grade point average.

DF = Degrees of freedom.

earlier. The female earnings differential is large and statistically significant for business, education and math and science majors, but not for other majors. Female business majors earn 18% less than their male counterparts; female education majors earn 22% less than their male counterparts; and female science and math majors earn 11% less than their male counterparts.

The female earnings gap in business is somewhat larger than the 11% differential found in a recent study of business graduates from one midwestern

university (Fuller and Schoenberger, 1991). The gender differential in education is much larger than one recently reported based on the same HLM technique using a large sample of experienced teachers (Lee and Smith, 1990). Earlier studies also found gender differences in the economic returns to college majors, but in some cases women graduates earned more and in some cases less than male graduates with the same major (Angle and Wissman, 1981; Daymont and Andrisanni, 1984).

According to the estimates, GPA had a significant

effect on the starting salaries of business and education majors, but not other graduates. A one-point increase in GPA was associated with starting salaries that were 10% higher for both business and education majors and 9% higher for science/mathematics majors. A similar effect was found for business majors in the study of graduates from a midwestern college (Fuller and Schoenberger, 1991).

Also reported in the top of Table 6 are the reliabilities for each of the parameters of the unconditional model. Low reliabilities suggest that much of the variance in the parameters is due to sampling variance and therefore cannot be explained by any school-level variables. The reliability of the mean earnings coefficient for engineering majors is low, suggesting that there is little between-school variance that can be explained through further analysis, but for comparative purposes, we continued to model it. Most of the other individual-level parameters also have low reliabilities ( $<0.2$ ), suggesting that attempts to model between-school differences in these parameters would be difficult.

The results of the chi-square table, shown in the bottom portion of Table 6, confirm these suspicions. The chi-square estimates show no significant differences in the mean between-school earnings of engineering majors, but significant differences in mean earnings of other majors between schools. The chi-square estimates for the female differential are significant for health and science/mathematics majors, suggesting that the female differential varies across schools for these groups, but not for others. The chi-square estimates for GPA are not significant at less than the 0.05 level for any major. The chi-square tests for *JOBNOTRL* was significant for only health and science/mathematics majors.

Since many of the predictor variables were either insignificant or unreliable, between-school differences were investigated with the two conditional models for only the intercept or base terms. The remaining variables were allowed to vary randomly across schools in those cases where the chi-square tests were significant (*FEMALE* and *JOBNOTRL* for health and science/mathematics majors); otherwise they were fixed.<sup>7</sup>

**Conditional model 1.** The next phase of the HLM analysis involved estimating the same within-school

model, but also estimating between-school differences in the intercept term in (3c). The results, shown in the top of Table 7, reveal that business, health, social sciences and science/mathematics graduates receive significantly higher starting salaries by attending more selective institutions (*SELECT*). A one hundred-point increase in college selectivity increases starting salaries by 2% for health graduates, 5% for business majors, and 6% for social science and science/mathematics majors.

The chi-square table, shown in the bottom part of Table 7, shows that significant differences in the intercept terms remain, even in those cases where college selectivity was significant. This suggests that continued analysis with another conditional model is warranted.

**Conditional model 2.** The last conditional model that was estimated was equation (3d), which included a wide array of institutional characteristics described above. The estimated parameters appear in the top of Table 8.

The results show that a number of the school-level variables were significant in predicting between-school differences in mean earnings, but the particular variables that were significant varied among the six groups. The dummy variable denoting private schools (*PRIVATE*) was not significant in any of the estimates. At least one of the three variables denoting social composition of students — *SELECT*, *PCTMINUG* and *PAEDUCM* — was significant in four of the six groups. Selectivity (*SELECT*), which represents the average SAT scores of freshmen, had a positive and significant influence on the mean salaries of science and mathematics majors, after controlling for the other institutional variables in the equations.

The minority composition of students (*PCTMINUG*) also had a positive and significant influence on the starting salaries for business, health and education majors, suggesting that students graduating from schools with higher concentrations of minorities command higher starting salaries (3 to 7% for each 10 percentage-point increase in minority concentration). This finding was surprising. A recent review of higher education research did not identify any previous studies that examined the effect of racial composition on labor market outcomes for white graduates (see Pascarella and Terenzini, 1991, pp. 456–457). A recent study did find that black college graduates from pre-

Table 7. HLM estimates of conditional model 1 by college major

	Engineering	Business	Health	Education	Social science	Science/mathematics
<b>Earnings</b>						
Mean	10.1039**	9.3429**	9.7141**	9.2494**	9.0743**	9.2261**
(Reliability)	(0.0520)	(0.4370)	(0.4920)	(0.3550)	(0.3270)	(0.4230)
SELECT	—	0.0005**	0.0002*	0.0002	0.0006*	0.0006*
<b>Female</b>						
Mean	-0.0488	-0.1787**	-0.0641	-0.2214**	-0.0867	-0.1140**
(Reliability)	—	—	(0.2360)	—	—	(0.1250)
SELECT	—	—	—	—	—	—
<b>GPA</b>						
Mean	0.0535	0.0961**	0.0273	0.1014**	-0.0454	0.0906*
(Reliability)	—	—	—	—	—	—
SELECT	—	—	—	—	—	—
<b>Unrelated</b>						
Mean	0.2023**	-0.1332**	-0.3149**	-0.1626**	0.0490	-0.3045**
(Reliability)	—	—	(0.6640)	—	—	(0.1880)
SELECT	—	—	—	—	—	—
<b>Chi-square table†</b>						
<b>Earnings</b>						
Est variance	0.0012	0.0163	0.0080	0.0155	0.0165	0.0214
DF	35	144	49	99	53	83
Chi-square	37.1670	273.6800	156.4200	158.9100	80.9490	146.7400
P value	0.3690	0.0000	0.0000	0.0000	0.0080	0.0000
<b>Female</b>						
Est variance	—	—	0.0303	—	—	0.0263
DF	—	—	50	—	—	84
Chi-square	—	—	94.0370	—	—	114.0800
P value	—	—	0.0000	—	—	0.0160
<b>GPA</b>						
Est variance	—	—	—	—	—	—
DF	—	—	—	—	—	—
Chi-square	—	—	—	—	—	—
P value	—	—	—	—	—	—
<b>Unrelated</b>						
Est variance	—	—	0.1892	—	—	0.0424
DF	—	—	50	—	—	84
Chi-square	—	—	209.1800	—	—	114.1500
P value	—	—	0.0000	—	—	0.0160

† The chi-square statistics are based on those schools that have sufficient data for computation. Additionally, these statistics are derived from univariate tests and do not take random effects in the model into account. These statistics should be treated as approximations.

\*\* Significant at the 0.01 level.

\* Significant at the 0.05 level.

HLM = Hierarchical linear modeling.

GPA = Grade point average.

DF = Degrees of freedom.

dominantly black institutions received higher initial salaries in one large manufacturing company than graduates from predominantly white institutions, but they also experienced lower salary growth (Solnick, 1990). The present findings could result from the positive effects of interracial peer influences, which were documented in a recent study of

high school students (Hallinan and Williams, 1990), or they could be due to the types of institutions that minorities attend. Minority institutions could do a better job of finding and placing graduates in jobs as a means to attract students.

Finally, a one-year increase in mean father's education (PAEDUCM) of RCG students

Table 8. HLM estimates of conditional model 2 by college major

	Engineering	Business	Health	Education	Social science	Science/mathematics
<b>Earnings</b>						
Mean	10.1224**	9.7084**	9.3706**	9.5294**	10.8792**	11.3125**
(Reliability)	(0.2220)	(0.3550)	(0.3450)	(0.0005)	(0.1820)	(0.2900)
SELECT	0.0001	0.0003	0.0003	0.0005	-0.0006	0.0007*
PRIVATE	-0.0476	0.0519	0.0263	-0.0397	0.0649	-0.0678
PCTMINUG	0.0026	0.0072**	0.0035**	0.0069**	0.0067	-0.0021
PAEDUCM	-0.0028	-0.0101	-0.0117	-0.0248	0.0267	-0.0827*
ATTRACT	-0.0008	0.0003	-0.0004	-0.0035**	0.0030	-0.0001
PATACPT	-0.0012	-0.0013	-0.0022*	-0.0056*	-0.0030	-0.0022
SFRATIO	-0.0005	-0.0024	0.0081**	0.0073	0.0095	-0.0029
PCTFCPHD	-0.0011	0.0001	0.0004	-0.0004	0.0008	-0.0012
PCTFACFT	-0.0025	-0.0007	-0.0035**	-0.0043**	-0.0026	-0.0039**
PCTUGFT	0.0042	0.0012	0.0058**	0.0035	-0.0072	-0.0004
PCTUG	-0.0011	-0.0013	0.0021	-0.0035	-0.0054	-0.0049
STDY100	-0.0001	0.0002	0.0001	-0.0001	0.0007	0.0002
<b>Female</b>						
Mean	-0.0488	-0.1787**	-0.0660	-0.2214**	-0.0867	-0.1148**
(Reliability)	—	—	(0.2520)	—	—	(0.1310)
<b>GPA</b>						
Mean	0.0535	0.0961**	0.0264	0.1014**	0.0454	0.0882†
Unrelated	—	—	—	—	—	—
Mean	—	—	—	—	—	—
(Reliability)	-0.2023**	-0.1332**	-0.3181**	-0.1626**	0.0490	-0.3045**
	—	—	(0.6660)	—	—	(0.1760)
<b>Chi-square table†</b>						
<b>Earnings</b>						
Est variance	0.0062	0.0115	0.0043	0.0002	0.0076	0.0119
DF	23	133	38	88	42	72
Chi-square	23.713	212.4100	84.1430	103.5400	52.7640	99.9590
P value	0.158	0.0000	0.0000	0.1240	0.1230	0.0160
<b>Female</b>						
Est variance	—	—	0.0330	—	—	0.0275
DF	—	—	50	—	—	84
Chi-square	—	—	93.9970	—	—	114.3000
P value	—	—	0.0000	—	—	0.0160
<b>GPA</b>						
Est variance	—	—	—	—	—	0.0390
DF	—	—	—	—	—	—
Chi-square	—	—	—	—	—	—
P value	—	—	—	—	—	—
<b>Unrelated</b>						
Est variance	—	—	0.1906	—	—	0.0391
DF	—	—	50	—	—	84
Chi-square	—	—	208.9400	—	—	114.2600
P value	—	—	0.0000	—	—	0.0160

† The chi-square statistics are based on those schools that have sufficient data for computation. Additionally, these statistics are derived from univariate tests and do not take random effects in the model into account. These statistics should be treated as approximations.

\*\* Significant at the 0.01 level.

\* Significant at the 0.05 level.

HLM = Hierarchical linear modeling.

GPA = Grade point average.

DF = Degrees of freedom.

decreased starting salaries for math and science majors by 8%. This result is also surprising. It could simply be an artifact of the kind of institutions attended by students with more educated fathers. Maybe those institutions do not have to try as hard to place graduates in lucrative jobs. Or perhaps graduates with more educated and possibly more wealthy fathers find jobs that pay less but provide other benefits, such as work conditions or training opportunities. But why this would be the case only for science and mathematics majors remains unclear.

The two measures of institutional popularity — attractiveness (ATTRACT) and the application acceptance rate (PCTACPT) — had countervailing impacts on starting salaries in two cases. For education and health majors, students attending schools with higher acceptance rates had lower starting salaries — 6% lower for each 10 percentage-point increase in acceptance rates for education majors and 2% lower for health majors. This suggests that graduates in those majors benefit from attending more “exclusive” institutions. Yet education majors also had initial salaries that were 4% lower for each 10 percentage-point increase in number of applications relative to institutional size. This suggests that for education majors, attending more popular campuses has negative consequences for starting salaries.

The effects of the resource variables were also somewhat surprising. Health graduates from institutions with high student–faculty ratios (SFRATIO) receive higher salaries than graduates from institutions with low student–faculty ratios. And health, science/mathematics, and education majors from institutions with a higher percentage of full-time faculties (PCTFACFT) have lower salaries than graduates from institutions with a lower percentage of full-time faculties. These findings suggest that 4-year colleges, which tend to have large student–faculty ratios and fewer full-time faculties may actually do a better job of helping graduates secure higher initial salaries, at least in the fields of health, education and science/mathematics.

Finally, of the variables that characterize the orientation of the school, only one was significant: a 10 percentage-point increase in the number of undergraduates attending school full-time was associated with a 5% higher salary for health majors.

The final chi-square table shown in the bottom of Table 8 suggests that average differences among

schools for education and social science majors became insignificant after including all the variables in the final conditional model. Significant between-school differences remain, however, for business, health and science/mathematics majors.

**Explained parameter variance.** The bottom part of Table 5 summarizes the estimated parameter variances for each HLM model in each group by showing the proportion of variance explained by each conditional model. The final conditional model explained a large proportion of the variance in mean earnings for each of the groups with values ranging from 42% for business majors to 99% for education majors. For engineering majors, where the between-school variance in earnings was smallest, the first conditional model with fixed regression slopes across schools explained two-thirds of the between-school variance.

#### IV. SUMMARY AND CONCLUSIONS

This study investigated three sources of qualitative influences on the initial earnings of college graduates: college major, college quality and college performance. Each of these factors has been shown in previous research to influence earnings. The present study addressed some of the limitations of this previous research. The data used in this study provided information on the earnings of recent, 1985–1986, college graduates; it included information on all three qualitative factors; and it included minorities and women as well as men in the sample. The study also employed HLM techniques in order to better test the influence of the institutional-level measures of college quality.

One important result in this study is that minorities receive either the same or even higher initial salaries upon graduation from college as whites. Yet women receive significantly lower salaries than men, even after controlling for differences in college majors and job characteristics. One possible explanation for this finding is that there are much fewer minority college graduates than whites and, therefore, they are in demand by firms seeking diverse workforces. But women are not in the same position and thus they continue to be disadvantaged relative to men in the labor market.

The results confirmed the importance of all three qualitative factors on earnings. College major had an important impact on earnings for men and

women, although the financial impact varied. For both groups, graduates in engineering and health commanded the highest relative salaries, but females received higher differentials than males. Science/mathematics and business majors were the next most lucrative majors for both groups. The groups with the lowest earnings were education, social science and humanities.

College performance, as measured by grade point average (GPA), influenced the earnings of women, but not men, after controlling for other factors. Among college majors, only business, health, and mathematics and science majors received a payoff for a higher GPA based on the HLM results. Why some groups should be compensated for better performance in school than others is not clear. In general, students with different majors compete for different jobs and could operate in different labor markets where credentials are valued differently. In tight labor markets, such as engineering, other credentials like institutional quality or performance may be unimportant to employers; in loose labor markets, such as business, employers may revert to the use of other credentials to differentiate among the graduates.

College quality also affected the initial earnings of college graduates, but different measures of college quality were influential for different groups of graduates. The HLM analysis revealed that there were significant between-school differences in the average earnings of all graduates except engineer-

ing. Measures of student social composition, faculty resources and institutional selectivity all helped to explain between-school differences in the earnings of some graduates, but not for all six groups of college majors. This could be because the samples of institutions were different for the various major groups. This suggests that it is hard to generalize about what institutional factors are important in explaining between-school differences in college earnings, and significant between-school differences in earnings remained for some groups even after controlling for the various measures of quality that were used. Additional research needs to be done to uncover other factors that could explain these differences.

Another question remains to be investigated as well. This study only looked at the impact of qualitative factors on initial salaries. Since at least some research suggests that different factors influence later earnings or salary growth, it is also important to examine what factors influence later salaries.

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## NOTES

1. We investigated whether there was any bias in our resulting sample. First, although the survey data we used had response weights to adjust for any response bias in the respondents, we were unable to use them in conducting the hierarchical linear modeling (HLM) estimates. In order to determine whether there might be response bias in the sample, we ran the OLS estimates reported below with both weighted and unweighted data and observed little difference in the size of the estimated coefficients. Second, we conducted the OLS earnings estimates (excluding the school variables) with and without the group who had missing school data, and again observed no large differences in the estimated coefficients. Finally, we compared the respondents enrolled in school with those not enrolled in school. Although the proportion of respondents in the two groups varied by college major, as one would expect, the proportions were similar among ethnic groups. Thus, our final sample appears to be representative of employed college graduates not enrolled in graduate school.
2. There are also sizable differences by race and ethnicity, but sample sizes were too small to produce accurate estimates.
3. For example, in 1986–1987, 2.7% of all bachelor's degrees were awarded to Hispanics and 5.7% were awarded to blacks, whereas 84.9% were awarded to whites (U.S. NCES, 1991, Table 235).
4. To the extent that there are unobserved differences in factors that influence both the choice of college major and earnings, then the estimated effect of college major on earnings could be biased (see Heckman, 1979). But since our models included a large number of variables that typically are associated with selection bias (such as ability, which is proxied by college GPA), then we would not expect there to be a large selection bias in the reported estimates. A recent study comparing earnings

- of high school graduates and dropouts that also employed comprehensive earnings models found little selection bias (see Stern *et al.*, 1989).
5. We further limited the number of schools to those having at least five graduates in order to increase the reliability of the estimated parameters.
  6. Adjusting the actual estimate for the within-school variance for the reliability of mean salary suggests that the between-school variance could actually range from 18 to 29% of total variance.
  7. We also conducted a more rigorous homogeneity test based on re-estimating the entire model to confirm that the homogeneity hypothesis was confirmed for those coefficients. See Raudenbush (1988) for details.

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Appendix A. Correlations among school-level variables

Correlations	PRIVATE	SELECT	PCTMINUG	PAEDUCM	PCIFACFT	PCIFCPHD	PCTUGFT	PCTUG	STDDBY100	ATTRACT	PCTACFT	SFRATIO
PRIVATE	1.0000											
SELECT	0.3973**	1.0000										
PCTMINUG	-0.0901	-0.3774**	1.0000									
PAEDUCM	0.2732**	0.6959**	-0.3920**	1.0000								
PCTFACFT	-0.0607	0.3963**	-0.0318	0.0995	1.0000							
PCTFCPHD	-0.0160	0.1315	-0.0986	0.1137	0.2582	1.0000						
PCTUGFT	-0.1882*	0.2180**	-0.1546*	0.2978**	0.3999**	0.0882	1.0000					
PCTUG	-0.4272**	-0.4335**	0.0118	-0.3160**	0.1498*	-0.1589*	0.0171	1.0000				
STDDBY100	0.3590**	0.1643*	-0.1067	0.2177**	0.1789*	0.0676	0.0098	-0.2293**	1.0000			
ATTRACT	-0.2213**	0.4783**	-0.1006	0.3577**	0.1030	0.0222	0.3464**	0.0775	-0.2748**	1.0000		
PCTACFT	-0.3630**	-0.5187**	-0.0948	-0.3778**	-0.0198	-0.0693	-0.1211	0.2458**	-0.0014	-0.5987**	1.0000	
SFRATIO		-0.3308**	-0.1029	-0.2105**	0.4599**	0.1864	-0.0814	0.2104**	0.1659*	-0.1957**	0.2138**	1.0000

N = 262. 1-Tailed significance testing.

\* Significant at the 0.01 level.

\*\* Significant at the 0.001 level.