

College Quality and the Wages of Young Men

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Abstract

Using the rich data from the National Longitudinal Survey of Youth, we show that several dimensions of college quality have substantial positive impacts on young men's wages. This finding is robust to a wide array of alternative specifications. Controlling for ability reveals that sorting of more able persons into better colleges accounts for only a modest portion of the unconditional quality effect. We find that young black men reap larger gains to quality than do young white men. Our results also indicate that attending a college with a racially diverse student body increases the later earnings of both white and black men.

JEL Codes: I2, J3.

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Each year, thousands of students (and their parents) invest their time, energy and money deciding where to go to college. With the cost of four years at an elite private college or university approaching \$100,000, this decision represents a major financial commitment for most families. For all the importance of this choice, little is known about the decision process itself or about how much it matters to the subsequent earnings and other outcomes of students.

In this paper, we explore the impact of choices about the quality of college to attend on the subsequent earnings of young men.¹ There is a large literature on the returns to higher education measured in terms of years of schooling completed or degree attainment, but less is known about the effect of college quality. At the same time, the relationship between educational quality and job performance is receiving increased public attention, and although much of that attention focuses on high schools, the ability of colleges to adequately prepare students for work is also a concern. Other current policy debates also touch on quality issues. Changes in student loan availability or costs will affect the decisions of students to attend public or private colleges and the quality of the education they buy. Changes in affirmative action or other “diversity” programs at colleges and universities would affect the quality of college educations available to members of various groups.

Deciding what college to attend involves an array of factors ranging from the family’s financial situation, to the student’s and his siblings’ intellectual abilities, to the perceived benefits of attending the various colleges. An economist looking at the consequences of these decisions can hardly ignore the nonrandom nature of college selection and the potential for

¹ In a companion piece, Daniel, Black, and Smith [DBS] (1995), we look at the relationship between college quality and wages of young women.

selection bias this may create.² Ability bias is of particular concern. Yet much of the small existing literature on college quality fails to control effectively for ability, background characteristics, labor market experiences, or earlier education. For instance, Weisbrod and Karpoff (1968), who use data from a single large employer, have only crude measures of college quality and the intellectual abilities of students, and no controls for family background. Reed and Miller (1970), using a 1967 Supplement to the Current Population Survey, have limited controls for individual abilities, as well as limited information on labor market experience. Similarly, Morgan and Duncan (1979), using the 1974 Panel Study of Income Dynamics, have only limited controls for intellectual abilities.

Wales (1973), Solmon (1975), Solmon and Wachtel (1975), and Wachtel (1976) use the National Bureau of Economic Research–Thorndike Sample of World War II veterans who volunteered for pilot, navigator, and bombardier training programs. While the NBER-Thorndike data include outstanding controls of individual ability, there is limited information on labor market experience, and the sample was drawn from a highly unrepresentative population. Also using a highly unrepresentative sample, albeit one rich in family and individual endowment measures, Behrman *et al.* (1995) estimate college quality effects among female twins born in Minnesota between 1936 and 1955.

In contrast to these earlier studies, we use unusually rich data from the National Longitudinal Survey of Youth (NLSY) to estimate quality effects from detailed wage regressions that control for previous labor market experiences, family and other background characteristics, and characteristics of respondents' high schools. The data also include a very good general ability measure, scores on the Armed Services Vocational Aptitude Battery. As such, our data most resemble those of James *et al.* (1989), Sweetman (1994), and Loury and Garman (1995), who use the NLS High School Class of 1972 data (NLSHS72) to examine the impact of college

² See Becker and Tomes (1976) for a model of family resource allocation relevant to college quality choice.

quality on wages. The NLSHS72 data also include information on the intellectual abilities of students, and the student's family background and high school, but the NLSY contains much better controls for the labor market experiences of workers. In addition, our data cover the most recent cohorts of young men currently available. This may be important because the pattern of results from research on high school quality suggests that the link between high school inputs and outcomes has weakened over time (Betts 1994).

College quality may affect wages directly, but may also act indirectly through labor force participation, the likelihood of attending graduate or professional school, the student's marital status and attributes of his spouse, the industry in which he later works, or the region in which he later lives. If college quality affects any of these outcomes, then wage equations that control for them will produce biased estimates. Ideally, we would like to estimate a structural model that accounts for the interrelationship among these factors. Our goal for this paper, however, is more modest: we seek to establish the reduced-form relationship between the quality of college education and male earnings. We find the empirical relationship to be robust across a wide variety of specifications.

We begin by reporting estimates from regressing wages on a constant and individual college characteristics, with and without controls for ability. These results form a baseline against which to compare our subsequent results. These estimates are unbiased only if all factors correlated with wages are orthogonal to college quality. While including ability controls generally lowers the return to college quality, the measures of college quality remain substantively and statistically significant. Following that, we estimate a series of standard wage regressions and report the coefficients on individual college characteristics. We continue to find a positive relationship between wages and many measures of college quality. These estimates are the correct measures of the return to college quality if college quality does not affect any of the individual characteristics that appear in the wage regressions.

While these various measures of college quality are often highly significant when we enter them individually in a wage equation, when we enter them collectively most are insignificant, with t-statistics less than one. As this suggests, the various measures of college quality are indeed highly correlated, a situation also noted by Solmon (1975), Morgan and Duncan (1979), and James *et al.* (1989). We exploit this collinearity and combine the various measures to construct a college quality index. We then substitute our quality index for the individual characteristics and explore the robustness of our basic finding that respondents who attend higher quality colleges have higher wages. We conclude with an empirical assessment of the plausibility of our quality effect estimates.

Our major findings can be easily summarized. First, we find that attending a higher quality college increases the wages of young men. This is true for a wide array of quality measures. This result is consistent with earlier work; we show that it is a robust relationship that endures even with detailed controls for individual ability, labor market experience, family background, high school quality, and industry of employment. Our point estimates of the effect of quality are consistent with the returns found for other forms of human capital, and are consistent with our estimate of the price of quality.

Second, the returns to college quality are substantially higher for black men than white men. This is consistent with the findings of Loury and Garman (1995) from the NLS Class of 1972. Furthermore, we find that for white men, up to a point, attending schools with a higher fraction of black students raises their wages. This is a robust relationship that exists even with controls for college quality, ability, family background, high school quality, college major, and industry of employment. There is weaker evidence that for black men, after a point, attending colleges with a higher fraction of black students lowers their wages. Taken as a whole, our results suggest that attending colleges with relatively diverse student bodies increases the earnings of both black and white men.

Finally, there is only very weak evidence that attending a public university *increases* the wages of men, although, consistent with what Solmon (1975) found in the Thorndike sample, we find that after controlling for college characteristics the difference between public and private colleges is not statistically significant.

DATA

Our data come from three sources. Our primary source is the National Longitudinal Survey of Youth (NLSY), panel data based on annual surveys of a sample of men and women who were 14–21 year old on January 1, 1979. Respondents were first interviewed in 1979 and have been re-interviewed each year since then. Of the five subsamples that comprise the NLSY, we use only the representative cross-section and the minority oversamples. After deleting observations with missing or inconsistent data, we are left with about 3,000 men.³

The NLSY provides unusually detailed information about respondents' employment histories, including detailed information about wages, experience, and tenure. It also provides, in addition to the usual demographic and other controls, the identity of colleges respondents attended. Thus, for each respondent who attended college, we were able to attach the college's characteristics.⁴ Our sources for college characteristics are the Department of Education's Integrated Postsecondary Education Data System (IPEDS) for 1990 and the *US News and World Report's* Directory of Colleges and Universities (1991). The former source provides most of the information about the colleges and their faculties; the latter provides most of the summary

³ Comparisons of means for white men revealed no evidence of bias from eliminating observations with missing or invalid data. Among black men, there is some evidence that removing observations with missing values tended to select for respondents with stable employment.

⁴ We attached 17 college characteristics: nominal tuition, spending per student, enrollment, the student/faculty ratio, percent of faculty with a Ph.D., the acceptance rate, 1st-year retention rate, graduation rate, percent of students who are black, percent of students who are women, mean, 25th, and 75th percentile SAT scores of first-year students (ACT scores are converted to SAT equivalents), and percent of first-year students who were in the top 10 and top 25 percent of their high school classes, and an indicator of whether the college is public or private.

information about colleges' students. We only included information for four-year colleges; roughly one half of the people in our sample with some type of postsecondary education attended a four-year college. The variables are described more fully in the Appendix.

Whenever necessary, we redefine the raw college characteristics so that larger values correspond to obvious notions of quality. For example, we transform the acceptance rate reported in the raw data into a rejection rate, under the assumption that more selective colleges are of higher quality, but college size appears untransformed. Large size might be a disamenity, but it is not at all obvious that it should be treated as a potentially negative indicator of quality. To the extent that small size limits specialization, larger schools can provide higher quality education both because they can reap efficiency gains from specialization and because they can offer more courses and so more closely match a given student's optimal curriculum. Diseconomies of scale presumably emerge at some point for the usual reasons.

Of course, each variable is an imperfect indicator of quality. For the rejection rate, observed rejections are not conceptually the correct measure of selectivity when students apply to colleges rationally and applying is costly at the margin. Furthermore, selectivity will have different meanings for private and public schools, because many of the latter are constrained to accept all or almost all state residents who apply. One can raise similar concerns about the other variables, but there are no compelling reasons to believe the characteristics as redefined are *inversely* related to quality. Larger values should correspond to higher quality.⁵

⁵ One concern that can be raised about many of the statistics is that colleges know prospective students treat them as quality measures. *The Wall Street Journal* (1995) reports that many colleges mis-report these statistics for marketing purposes, but it is unlikely that mis-reporting produces a negative relationship between reported and actual values.

ESTIMATION RESULTS FOR COLLEGE QUALITY

In this section we estimate the effect of college quality on wages. The dependent variable in each regression is the natural log of real wage in 1987. Estimated coefficients are from OLS regressions on the set of working respondents not enrolled in school.⁶ Using Koenker's (1981) robust version of Breusch and Pagan's (1979) test, we easily reject the null hypothesis of homoskedastic errors in our baseline quality index regressions, described below in the section "College Quality Index in Wage Regressions." Therefore, we estimate covariance matrices using White's (1980) heteroskedasticity-consistent estimator. Given our strong presumption that college quality could only enhance human capital, there is a strong case for performing one-tail significance tests. We report, however, the more conservative two-tail significance tests because although it is quite unlikely that higher quality colleges provide less human capital, it is possible that quality affects wages in other ways. For example, it is conceivable that college quality affects social or leisure capital or home production in ways that lower wages.

We estimate standard Mincer wage regressions of the form

$$(1) \quad \ln W_i = c + Q_i\Gamma + A_i\alpha + X_i\beta_X + Z_{Hi}\beta_H + Z_{Pi}\beta_P + Z_{HSi}\beta_{HS} + \varepsilon_i,$$

where c is a constant, Q is a vector of college characteristics (often a single characteristic), A is our set of ability controls, X is a standard set of wage regressors, and the Z_j are vectors of background characteristics: Z_H , Z_P , and Z_{HS} describe the early home environment, the respondent's parents, and the respondent's high school, respectively. ε_i captures the effect of all omitted influences. The regressors will be explained in more detail later.

⁶ As reported in DBS (1995), we have repeated some of the analysis for women, estimating wages and participation simultaneously using the model described by Heckman (1976, 1979). Doing so has little effect on the quality coefficients or their (full-information) standard errors.

Baseline Quality Regressions

Table 1 reports the coefficients on college characteristics in wage regressions that exclude X and Z , except for an indicator for whether the respondent completed at least one year of any postsecondary school. These are the correct, reduced-form measures of the impact of college quality only if the college quality indicators are uncorrelated with all omitted wage determinants or if quality determines those omitted variables for which the correlation is not zero. The former assumption is at least plausible, but neither is attractive. These estimates, however, provide a convenient way to present summary correlations in the raw data.

Each college characteristic appears in two wage regressions. The first includes a single college characteristic (Q), the postsecondary school indicator, and a constant; the second adds controls for ability (A). If the college characteristic was missing for a respondent, it was set to zero; all regressions include a dummy variable indicating when the college characteristic was unavailable. The ability controls are based on the Armed Services Vocational Aptitude Battery (ASVAB). The ability controls are the first two principal components of respondents' age-adjusted scores on the 10 exams that comprise the ASVAB, and these two variables squared.⁷ We describe the ASVAB and the age adjustment procedure in the Appendix.⁸

Table 1 reports regression coefficients for 14 college characteristics. Without ability controls, 13 of the 14 characteristics have positive coefficients that are statistically significant at 5 percent. The exception is the SAT interquartile ratio (the ratio of the 25th to 75th percentile SAT scores), a measure of the dispersion of student abilities. Its coefficient is positive, indicating that lower dispersion is associated with higher wages, but it is not significant at the 10

⁷ See Cawley, et al. (1995) on using the first two principal components of the ASVAB scores.

⁸ We have repeated much of our analysis using only the first principal component of the unadjusted ASVAB scores, and using (unadjusted) Armed Forces Qualifying Test (AFQT) scores in place of our age-adjusted principal components. In both cases we obtain results very similar to those reported. The AFQT is a weighted average of scores on four of the ten ASVAB tests.

percent level. None of the regressions explains more than five percent of the variance in log wages. When ability controls are added to the regressions, nearly all of the point estimates are reduced, but they remain positive. All of the 13 significant characteristics remain significant at the 5 percent level, and the SAT interquartile ratio remains insignificant at the 10 percent level. High ability men attend better colleges, but conditional on ability, men who attended higher quality colleges earn higher wages. Here and in the tables that follow, using OLS estimates of the covariance matrix in place of the heteroskedasticity-consistent estimates reported produces nearly identical qualitative results.⁹

Table 1 also reports results from regressions that include the percent of students who are female. Some have argued that students, especially female students, who attend schools with a higher proportion of their own gender will learn more (for example, see Tidball 1989). We were skeptical of this argument, especially for men, but surprisingly, we find a negative relationship between the wages of men and the percent of their college's students who were female. The range of this variable, however, is relatively small; among men in our sample, the 25th and 75th percentiles are 48 and 57 percent female, respectively.

College Characteristics in Wage Regressions

We now turn to estimates of coefficients on college quality obtained from detailed wage regressions. At a minimum, each regression includes a constant, quartics in four variables—age, tenure, pre-college-graduation labor market experience, and post-graduation experience—controls for race, geographical region, urban residence, any postsecondary school completed, years of school completed, years of school completed after high school, having a 4-year degree, and the ability controls described earlier. These variables are summarized in the Appendix. We

⁹ College quality differences are not simply proxying for race. When the sample is restricted to non-hispanic white men (not shown), the point estimates are generally smaller, but otherwise the results are very similar to those for the full sample. As for all men, wages are related to college quality, and we find indirect evidence of positive ability sorting.

separated pre- and post-graduation experience because we were concerned that college quality might be correlated with forfeiting occupation- or industry-specific human capital acquired from pre-graduation work.¹⁰

In each of the tables we report results from specifications that include only the basic set of regressors described above, as well as those that add college major, union status, and industry indicators. If better colleges produce their effect by being better at producing students who succeed at more remunerative majors or find jobs in high-wage industries, then the basic specification provides the correct reduced form estimates. To the extent there is correlation without causation from college quality to college major or industry, however, the latter specifications provide the correct estimates.

Table 2 reports coefficients for the college characteristics. It matters little whether college major and/or industry controls are included; with few exceptions the point estimates are statistically significant and are very similar in all specifications. For example, the coefficient on spending per student is .053 in the basic regression and .057 in the regression that controls for college major and industry. Its coefficients in all three specifications are significant at better than the 5 percent level. Although not large, the coefficients are substantially significant. The smaller coefficient from the basic regression implies that a man who was a student at a college with spending per student at the 75th percentile earns wages about 2 percent greater than an otherwise identical man whose college had the median spending per student.¹¹ Men from colleges with mean SAT scores at the 75th percentile earn about 3 percent higher wages than similar men from schools at the median. The point estimates for most characteristics imply differences in wages of about these magnitudes. Most of the estimates are significant at 5

¹⁰ Treating pre-graduation and post-graduation experience separately is justified by F-tests at better than a 1 percent level of significance, but has little effect on our estimates. (Generally, separating experience marginally improved the precision of some estimates in some specifications.)

percent; nearly all are significant at 10 percent. The only exceptions are tuition, which is not significant in any specification, size, which is only significant in the full specification, and the interquartile ratio, which is only significant at the 10 percent level when industry controls are absent.

We estimated an additional specification when we included the Average, 25th, or 75th Percentile SAT. We were concerned that these college characteristics might be proxying for the SAT scores of respondents, and that the latter might be correlated with wages. Perhaps not surprisingly given that we always control for ability as revealed by ASVAB scores, we found no evidence of bias arising from this source. Including respondents' combined verbal and math SAT score has essentially no effect on the estimated effect of the college aggregate SAT measures (see Table 2, page 33, lower panels, and accompanying note).

We continue to find a negative relationship between men's wages and the proportion of their college's students who were female. To allow for nonlinearities in the relationship, we replaced the proportion female variable with quartile dummies. These estimates also reveal a negative relationship between proportion female and wages. The presence of female students continues to lower male wages even when we control for college major. Thus, the percent students female is not simply a proxy for different types of college majors at colleges that attract female students.¹²

In Table 3 we explore the possibility that some of the quality measures are proxying for whether a college is public or private. The most obvious candidates are tuition and size; we also consider spending per student and the faculty/student ratio. When an indicator for whether a college is private is included in tuition regressions, the point estimates for tuition are 5 to 10

¹¹ See Table A 5; percentiles refer to the distribution of college characteristics among men in our sample, not colleges.

times as large as in the regressions without the private school indicator (reported in Table 2); the tuition estimates achieve significance at 5 percent when industry controls are absent. The point estimates imply that wages rise by about 2 percent for every \$1,000 increase in annual tuition. The point estimates also suggest that from the perspective of an individual student, public colleges are a good buy.

Once we control for size, spending per student, or the faculty/student ratio, whether or not the college is private does not appear to matter, and the point estimates are positive when the faculty/student ratio is included. Furthermore, controlling for private schools does not affect the positive relationship between these three measures of quality and wages. The estimated effect of spending per student and the faculty/student ratio are larger, and the estimated effect of size is the same with or without the private school indicator (see Table 2). Solmon (1975) also found no statistically significant difference for the wages of his sample of World War II veterans between public and private colleges once he controlled for the characteristics of the colleges; our results suggest that public colleges continue to be a good buy for the individual male student.

Table 4 reports evidence on one last potential measure of quality, the percent of a college's students who are black. Some have made arguments suggesting this should be a quality measure for black men. We find no evidence this is so for blacks, but, paradoxically, we find evidence that the percent students black does increase the wages of white men. Whether or not we control for college major and industry, there is evidence of a positive effect for white men, but not for black men (top panel).¹³ In the bottom panel we report results from regressions in which we relax the requirement that percent black have a linear effect. In these regressions we include dummy variables indicating in which quartile the respondent's college fell with

¹² This is broadly consistent with the findings of Sweetman (1994), who found that men, but not women, attending single sex schools earned significantly higher wages.

respect to the proportion of its students who are black. The quartile indicators are defined separately for whites and blacks. Again, regardless of whether or not we control for major and industry, we find no evidence for black men that wages are positively related to the racial composition of their college. If anything, we find evidence of just the opposite. Although not statistically significant, the point estimates for black men are large and negative. For white men, we find very large, statistically significant positive effects. The different effects for whites and blacks suggest the Percent Black variable is not simply proxying for college quality. We present direct evidence of this later.

The typical black worker in our sample attended a college with a very different racial makeup than that of the typical white worker. For white men, the 25th percentile school has a student body that is 2 percent black; the 50th percentile is 5 percent; the 75th percentile is 8 percent. For black men, the 25th, 50th, and 75th percentiles are 7, 16, and 83 percent, respectively (see Table A 16 and Table A 17 in the Appendix). One interpretation of our results is that racial diversity among students is productive for both black and white men.¹⁴

In general, there is broad-based evidence from detailed wage regressions that college quality raises men's wages. Even after controlling for all the usual wage determinants, including ability, industry of employment, and college major, men who attend higher quality colleges earn higher wages. All of the variables with obvious quality interpretations appear to produce

¹³ Using the more disaggregated college major indicators described in the Appendix has almost no effect on the point estimates on Percent Students Black, but slightly increases the precision with they are estimated (not shown).

¹⁴ Another interpretation is that a relatively high proportion of black students (or a relatively low proportion of white students) is a disamenity for white men and an amenity for black men. Under this interpretation, our results follow from students being willing to forego college quality to achieve a student body composed more to their taste. This is an unlikely explanation of our results for at least three reasons. First, it would seem to require implausibly large quality effects (and a very high price on student composition) to account for the differential earnings among whites. Second, it requires that low quality colleges, but not high quality colleges, offer attractive student body compositions. Even if students forego person-specific match quality rather than general quality, the large number of colleges with small proportions of black students should make indulging this taste very inexpensive for whites. Third, we report evidence later that directly contradicts this interpretation (see Table 8).

modest, but significant, positive effects. In addition, we find significant effects for some of the variables with less certain quality interpretations. Men who attend colleges with student bodies composed of a higher proportion of women earn lower wages. There is some evidence that diversity in ability among students is a negative quality attribute, but racial diversity may be a positive quality attribute. There is some evidence that for given tuition, public schools provide more human capital, but this appears to be explained largely by different levels of spending per student, the faculty/student ratio, and/or size. Once one controls for these variables, the public school advantage disappears or is greatly reduced.

College Quality Index in Wage Regressions

In our sample, characteristics are strongly correlated across colleges. A high degree of correlation among characteristics has been noted by others as well (Solmon 1975; Morgan and Duncan 1979; James *et al.* 1988). A college with high spending per student is likely to have a high faculty/student ratio and to have a large fraction of students with high SAT scores. Indeed, we estimated regressions with 14 different measures of quality (Appendix Table A7) with three specifications: the basic specification similar to the regressions in Table 2, the basic specification plus controls for college major, and the basic specification and controls for college major and industry. Only three variables attained significance: the faculty-student ratio (at the five percent level in each specification), the fraction of faculty with Ph.D. (at the 10 percent level in the specification that contains college major controls, but no industry controls), and the proportion female (at the 5 percent level in all specifications). For this reason, and to simplify the interpretation of our empirical results, we constructed an overall “quality index” equal to the first principal component of a subset of college characteristics.¹⁵

¹⁵ Factor analysis and principal components analysis produced indices with very high rank order correlation (.99 for the six variables we use). We experimented with including both the first and second principal components in wage regressions, but the second principal component’s coefficient was always small and statistically insignificant (see Appendix Table A 10).

The desire to produce a quality index for as many colleges as possible guided our choice of which characteristics to include in the principal components analysis. Because many colleges fail to report one or more characteristics, we were generally able to calculate a quality index for a larger number of colleges, the smaller was the set of characteristics considered. Balancing this incentive to keep the set of characteristics as small as possible was our desire to use as much information as possible about each college, and the empirical fact that if we used only two measures, the rank order correlations between the indices produced were relatively small, in the range of .5 to .7. Once at least three or four variables were included in the sets, it did not matter much which variables we chose to include, all indices produced were highly correlated.¹⁶

We settled on using as our quality index the first principal component of six variables: spending per student, the faculty/student ratio, the rejection rate, average SAT of first year students, and the percent of first year students who were in the top 10 and top 25 percent of their high school classes.¹⁷

Appendix Table A 8 summarizes the principal components analysis for the six college characteristics. There is one dominant principal component, which explains 63 percent of the variance of the six variables. We call it “quality.” Appendix Table A 9 lists the top 50 colleges as ranked by this quality index. This list illustrates what the signs of the elements of the eigenvector in Table A 8 suggest, that our quality indicator corresponds to *a priori* notions of

¹⁶ We did not explore all possible permutations, but instead formed sets that produced relatively few missing observations. For example, many colleges report spending per student, but many fewer report the 25th percentile SAT score of first year students, so we did not construct the first principal component of spending per student and 25th percentile SAT score. For sets larger than two, the correlations between the quality indices produced were quite high, generally greater than .8 and often greater than .9.

¹⁷ To check the robustness of the results we report later, we experimented with an alternative quality index constructed from only two characteristics describing educational inputs, spending per student and the faculty/student ratio. While the ranking of colleges implied by this alternative index differed somewhat from that produced by our standard index, substituting it in regressions had little effect, as described in the notes accompanying some of the tables that follow.

college quality. We report evidence later that after controlling for other college characteristics, tuition is positively related to this quality index.

In this subsection we substitute our quality index for the individual college quality indicators used in the previous subsection. As in the previous subsection, each table reports results from specifications that differ by whether we control for the college major of the respondent and the industry in which he works. In addition, we include background controls that fall into three categories: those describing respondents' home environments, parents, and high schools. Such characteristics have been found to be correlated with schooling in other contexts, and are plausibly correlated with omitted asset or other variables independently affecting both college choice and human capital. Some of them may be correlated with cognitive or other abilities that affect both quality choice and later wages. The background variables are described in the Appendix (Table A 3).

Table 5 reports results from regressions using college quality in place of individual college characteristics. We report results for two quality indicators: the raw quality index and four dummy variables indicating the quality quintile into which each college falls (the lowest quintile is the omitted category). The results are consistent for the two quality indicators; men who attend better colleges earn higher wages. This is true whether or not we control for college major and/or industry, and controlling for college major and industry has little effect on the point estimates. The quality effects are large. According to these estimates, men who attend colleges in the top fifth of the quality distribution earn wages about 18 percent higher than otherwise identical men who attend colleges in the bottom fifth of the quality distribution.¹⁸

¹⁸ The quintile estimates are consistent with the quality effects implied by the linear estimate. The mean values of quality in the first through fifth quintiles are -2.00 , -1.05 , -0.18 , 0.48 , and 3.33 , respectively. The linear estimate of $.038$ thus implies quality effects of $.036$, $.069$, $.094$, and $.203$ for the second through fifth quintiles, respectively. The middle quintile point estimates exceed the effects implied by the linear term, but the deviations are not statistically significant.

We have not interacted college quality with any measures of the duration or intensity of students' college experiences, although such interactions are certainly plausible. To test for interactions between college quality and the duration or intensity of the college experience, we interacted our quality measure with years of schooling beyond high school and receipt of a 4-year degree (see Appendix Table A 11). F-tests fail to reject at 15 percent the simpler specification without quality interaction terms. Interestingly, Solmon (1975) found no relationship between the earnings of his World War II veterans and how long they had attended the college.

The next few tables report results from regressions that include family and high school background variables. If these background characteristics are correlated with omitted asset or other variables independently affecting both college choice and human capital, then the results in Table 5 are biased. We find no evidence of this.

Table 6 reports results from adding background variables to the basic regressions of Table 5. Adding background variables has very little effect; neither the point estimates nor the standard errors change materially. The largest absolute change in any coefficient in any specification is .006. Adding all background variables to the regression does not alter the coefficient on the quality index or its standard error (See Table A 12 and Table A 13 in the Appendix).¹⁹

¹⁹ Home characteristics are jointly significant at 10 percent or better, except when detailed college major and industry controls are present (see Appendix Table A 14). When major and industry controls are present, and other background controls are absent, whether or not someone in the respondents' household received newspapers and whether anyone had a library card are significant at 10 percent. There is stronger evidence for the Parents background controls. The Parents controls are jointly significant at 10 percent or better in all specifications, although except for some of the parental occupation indicators, none of the controls are individually significant in any specification. Respondents' mothers', but not fathers', occupation controls are jointly significant at the 5 percent level or better in all specifications. There is very strong evidence of a relationship between men's high school characteristics and wages. These characteristics are jointly significant at the 5 percent level or better in all specifications. The starting salary of teachers in respondents' high schools is individually significant at 5 percent or better in all specifications, as is total enrollment when major and industry controls are present. Our estimates imply that controlling for college quality, a man who graduated from a high school at the 75th percentile of teachers' starting salaries

Thus there is little evidence that omitting family or high school characteristics is responsible for our earlier results. This also provides indirect evidence on the role of unobserved heterogeneity. To the extent the background variables are correlated with omitted assets, cognitive or other ability, or unobserved human or social capital, these last few tables suggest that unobserved variation in the latter are not responsible for our results.

Finally, in Table 7 we report estimates from regressions in which we replace the standard set of college major controls with the 81 detailed college major controls described in the Appendix. In all other respects the regressions are the same as those underlying Table A 12. The point estimates of the quality effect are slightly smaller when the more detailed college major controls are used, but overall, across all specifications the results are very similar in both sets of regressions. There is no evidence that our earlier results are materially affected by heterogeneity within our broader college major definitions.²⁰

Table 8 and Table 9 repeat and extend our earlier analysis of the effect of the percent of a college's students who are black. Table 8 repeats our earlier analysis, but now controls for college quality. The earlier results are confirmed. Whether or not we control for background characteristics (bottom and top panels, respectively), we find no evidence of a positive effect for black men. We find, however, that controlling for college quality, white men who attended colleges with higher proportions of black students earn significantly higher wages. As in the earlier analysis, these results are confirmed when percent black quartiles (not shown), defined

earns about 3 percent more than a similar man whose high school is at the 25th percentile. While much of the debate about whether primary and secondary schools characteristics affect learning has focused test scores (see Hanushek, 1986 for a review of the literature), evidence using wages is mixed. See Card and Krueger (1992), Betts (1994), Heckman, *et al.* (1995), and Altonji and Dunn (1995) for recent contributions. As far as we know, Wachtel (1976) is the only other paper that includes both high school and college characteristics, and he also finds that both high school and college characteristics affect wages.

²⁰ As yet another test of robustness, we re-estimated our model using a Cox regression model. Commonly used in duration analysis, the Cox model relies only on the rank of the dependent variable; it does not

separately for blacks and whites, are included in place of the linear percent black term. Rather than report the replication of these earlier results, we constructed new percent black indicators, defined to be the same for blacks and whites.

We construct four categorical variables from the Percent Black variable: less than 5 percent black, between 5 and 7 percent black, between 8 and 17 percent black, and more than 17 percent black.²¹ We report results for the entire sample as well as subsamples of white and black men in Table 9. For the sample of all men, those attending colleges with between 5 and 7 percent black students earn more than those attending colleges with fewer than 5 percent black students. Similarly, men attending colleges with between 8 and 17 percent black students earn more than students attending schools with fewer than 8 percent black students and more than 17 percent black students. Interestingly, for whites, attending colleges with more than 17 percent black students increases wages more than attending colleges with between 5 and 7 percent black students, but for blacks, the opposite result holds, although neither difference is statistically significant. Thus, the evidence seems to suggest that a diverse student body raises the wages of both whites and blacks.

Recently, Loury and Garman (1995), using the NLS High School Class of 1972 data, report that blacks receive a higher return to attending selective colleges than comparably qualified whites. In Table 10, we look for this effect in the more recent NLSY data by interacting our quality index with a dummy variable indicating that the individual is black. In each specification, blacks have a higher return to college quality than whites, and except for the base specification, the difference is significant at the 10 percent (two-tailed) level. Moreover,

assume a distribution for it (see Table A 15 in the Appendix for the results). Using the Cox model, we estimate that college quality significantly increases wages.

²¹ These categories were chosen to ensure that each had sufficient numbers of black and white men. See Appendix Table A 16 and Table A 17 for the distribution of men across schools defined by percent students black; see the note to Table 9 for category cell sizes.

the point estimates indicate that the return to quality for blacks is nearly three times that for whites.

Table 11 reports our estimates of the effect of tuition, size, and proportion female, controlling for quality. Once we control for college quality, we find no evidence that men's wages are related to the tuition they paid. In regressions including both tuition and the Private indicator, the point estimates on both variables are negative and statistically insignificant. Once we control for quality, size has no effect. The point estimates for both Size and Private are not statistically significant at customary levels, either individually or jointly.

There is now only very weak evidence that the proportion of a college's students who are women lowers men's wages. The point estimates are negative for the proportion female (when it enters linearly) and for the highest quartile (when proportion female is represented by quartile dummy variables), but the only coefficient estimate to achieve 10 percent significance is that on the proportion female when college major and industry controls are present, but background controls are not. Compared to the earlier regressions that did not control for quality, the standard errors are about the same, but the point estimates are smaller.

Overall, our quality index results for men are consistent with those reported earlier for individual college characteristics. We continue to find evidence of a statistically and economically significant benefit to college quality, regardless of whether we control for college major, industry of employment, or a wide range of family background and high school characteristics. Even after controlling for college quality and background characteristics, we continue to find evidence consistent with racial diversity among students raising productivity. After controlling for quality, we find no evidence of a private school effect, and the evidence that men's wages are inversely related to the proportion of women at their colleges is greatly weakened. Finally, controlling for college quality and family and parental background

characteristics, we find that earnings of teachers at men's high schools are positively related to their later wages.

Difference Estimates

We now briefly explore the way in which quality affects wages. Specifically, we see whether there is evidence that a high quality college education complements or substitutes for on-the-job human capital accumulation. For example, higher quality colleges might provide students with a superior ability to accumulate human capital. If so, wage growth should be greater for people who attended higher quality colleges. So far, we have assumed this is not the case. The estimates we report here suggest that this assumption is justified.

All of the estimates we have reported are from single period regressions of the form

$$(2) \quad \ln W_t = \gamma Q + Z\Gamma + X_t\beta + e_t,$$

where Z now represents all non-time varying controls except quality (Q), and X_t is all time-varying controls. In differences, this becomes

$$(3) \quad \Delta \ln W_t = \Delta X_t\beta + \Delta e_t.$$

We can write our alternative hypothesis, that high quality education affects the ability to accumulate human capital, so that it includes equation 2 as a special case:

$$(4) \quad \ln W_t = \gamma Q + \delta(tQ) + Z\Gamma + X_t\beta + e_t,$$

where t is tenure or post-college experience. For someone employed steadily between periods, in differences this becomes

$$(5) \quad \Delta \ln W_t = \delta Q + \Delta X_t\beta + \Delta e_t.$$

Equation 5 nests equation 3, so there are two ways to test whether equation 2 or 4 is correct. We can estimate equation 4 directly or we can estimate equation 5. In either case, our alternative hypothesis suggests we should reject $\delta = 0$. If we have specified the functional form correctly

and there is no relevant unobserved heterogeneity, then the two tests are equivalent. Equation 5 produces fixed effects estimators so if the functional form is correct only up to fixed effects, then equation 5, but not equation 4, will produce an unbiased estimate of δ , and the two strategies might produce different estimates.

Whether we estimate equation 4 or 5, we cannot reject the null hypothesis represented by equation 2. Table 12 reports estimates of equations 4 (top panel) and 5 (bottom panel). There is no evidence from either set of regressions that college quality is related to the speed with which people later accumulate human capital. In addition, whether or not a man graduated from a private college is unrelated to wage growth. We repeated the analysis with our ability controls present to allow for the possibility that higher ability workers might accumulate human capital at different rates than lower ability workers. Including these controls had no effect on the qualitative results. This is contrary to the findings of Sweetman (1994) and Solmon (1975) who found that college quality was positively related to wage growth.

Are the Estimates Plausible?

We have produced estimates of the return to college quality. If we are willing to make some simplifying assumptions we can answer the question, “Do wages increase enough to pay for the added financial investment required to attend a good college?” More importantly, given that the additional assumptions are reasonable, we can use our answer to gauge the believability of our quality effect estimates. If the market for college quality is in equilibrium, then at the margin, the price of quality should just offset its return. We have estimates of the average return, so because presumably most students are inframarginal our estimates of the return to quality should exceed our estimated price of quality.

To get a sense of whether the magnitudes of costs and benefits implied by our estimates are plausible, we compare our direct estimates of the wage effect produced by college quality to

estimates of the wage effect that would just offset the additional cost of quality. The direct financial benefit from additional college quality is the present value of the additional earnings produced by the increment in quality. The cost is the present value of the additional tuition a student must pay each year to attend a higher quality college.

Denote post-graduation wage at time t by $w(t; q)$, where q is college quality. Assume students live forever, can borrow at their discount rate r , and take c years to complete college. Ignore any effort or other non-pecuniary costs or benefits to students of attending a higher quality college, and denote the difference in post-graduation wage associated with a difference in quality of $\Delta q = q_1 - q_0$ by $\Delta w(t) = w(t; q_1) - w(t; q_0)$. To simplify matters, we assume $\Delta w(t)$ is constant over time and therefore equal to the increment produced in the first wage received after college, $w(c)[\exp\{b\Delta q\} - 1]$, where b is our log wage regression estimate and $w(c)$ is the first wage received after college. We denote this constant, persistent wage effect by Δw . To the extent that college quality increases wage growth we underestimate the value of quality; if quality effects diminish over time we overestimate its value. Discounting reduces the importance of either of these sources of bias.

The dollar price of quality is ΔT per year in added tuition. Additional quality is worth buying if

$$(6) \quad \Delta w \int_c^{\infty} e^{-rt} dt \geq \Delta T \sum_{i=0}^{c-1} (1+r)^{-i},$$

$$\Delta w \geq \Delta T \left[\frac{1 - (1+r)^{-c}}{1 - (1+r)^{-1}} \right] r e^{cr} \equiv \overline{\Delta w}.$$

To evaluate this expression, we need an estimate of the price of quality, ΔT . We estimated this price by regressing tuition on our quality index and controls not used in the construction of the quality index that we hope are correlated with amenities and/or costs of providing a college education. These controls are quartics in Size, Percent Black, and Percent

Female. We also included the private college indicator and interaction terms between this indicator and all other variables in the regression. We performed the regressions on the set of all four-year colleges for which we had information. We experimented with several functional forms, each differing by the way quality entered the regression. Based on R^2 's and inspection of residuals we chose to include higher-order quality terms up to the fourth power. This functional form fits the data quite well.

Table 13 reports estimates from this admittedly ad hoc hedonic price regression; Figure 1 graphs the implied tuition-quality relationship for private colleges. Table 14 uses these price estimates to derive the break-even earnings effect for private colleges under different assumptions about the interest rate and time to complete a college degree. It also reports the earnings effects implied by our earlier quality estimates for three different increments in college quality: moving from a college at the 25 percentile of the quality distribution to one at the median, moving from the median to the 75th percentile, and moving from the median to the 95th percentile. The earnings effects are those implied for someone earning \$24,305, the beginning salary offered Bachelor's degree recipients in Business in 1992 (Census 1994; Table 289).²²

At the very least, Table 14 shows that our price and quality effect estimates are consistent with one another. Our estimates of the effect of quality imply wage increments of the same order of magnitude as those we estimate are required to justify the expense of buying extra quality. Assuming our price estimates are approximately correct, these figures suggest our quality effect estimates imply plausible earnings effects. Our estimates of the quality effect on wages are consistent with what it costs to buy quality.

²² Evaluation at the average beginning salary for Humanities graduates (\$22,941) does not greatly change the estimates.

CONCLUSION

College quality increases the wages of young men. Regardless of what controls we use or how we measure quality, there is a positive and significant relationship between wages and college quality. Our results are based on a representative sample of young men that includes detailed information on ability, labor market experience, family background, and high school quality. Because of the extensive controls that we have used and the stability of the parameters we estimated, it is doubtful that selection bias could explain this robust finding. According to our estimates, men who attend colleges in the top fifth of the quality distribution earn wages about 20 percent higher than otherwise identical men who attend colleges in the bottom fifth of the quality distribution. Our estimates of the quality effect are consistent with our estimate of the price of quality.

These estimates are in striking contrast to the primary and secondary school literature, where the evidence that easily quantifiable school characteristics matter for later productivity is at best mixed. One explanation may be a greater dispersion in resources and other characteristics among colleges compared to primary and secondary schools. It may also be evidence of monopoly rot within the largely public high school system. Public colleges face a more competitive environment than do public high schools, and therefore may deploy resources in ways more beneficial to students, with the result that variation in college characteristics more closely matches variation in quality. Our failure to find positive private college effects for men, while others have found positive private high school effects, is consistent with this explanation.

The returns to college quality are significantly higher for black men than white men. Perhaps our most intriguing results are those suggesting the possibility that racial diversity among a college's students is productive. This may be indirect evidence of the productive benefit of social or cultural capital. Unfortunately, our ability to explore this phenomenon is

limited by the large differences in our sample between the racial makeup of colleges attended by blacks and those attended by whites.

Table 1: Wages Regressed on College Characteristics
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=3,100)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ability Controls		YES		YES		YES		YES
College Characteristics:								
Tuition (\$1,000s)	.018** (.006)	.015** (.006)						
Spending per Student (\$1,000s)			.011** (.002)	.009** (.002)				
Faculty / Student Ratio					3.26** (.841)	2.98** (.846)		
Size (10,000s)							.038** (.014)	.029** (.014)
R² (adjusted)	.04	.07	.04	.07	.04	.07	.03	.07

(N=3,100)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ability Controls		YES		YES		YES		YES
College Characteristics:								
Rejection Rate (ratio)	.421** (.123)	.429** (.122)						
1st Year Retention Rate (ratio)			.742** (.135)	.625** (.136)				
Graduation Rate (ratio)					.463** (.115)	.374** (.116)		
HS Top 10% (ratio)							.434** (.120)	.354** (.120)
R² (adjusted)	.03	.07	.04	.07	.04	.07	.04	.07

(Continues)

Table 1 (continued): Wages Regressed on College Characteristics
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=3,100)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Ability Controls		YES		YES		YES		YES
College Characteristics:								
Average SAT (100s)	.073** (.013)	.061** (.013)						
75th Percentile SAT (100s)			.063** (.017)	.055** (.017)				
25th Percentile SAT (100s)					.059** (.017)	.051** (.017)		
SAT Interquartile Ratio (.445)		(25th / 75th)					.615	.554 (.463)
R² (adjusted)	.04	.07	.05	.08	.04	.07	.04	.07

(N=3,100)	(1)	(2)	(3)	(4)				
Ability Controls		YES		YES				
College Characteristics:								
Faculty PhDs (ratio)	.495** (.108)	.422** (.108)						
Proportion Female (decimal)			-.510** (.150)	-.420** (.145)				
R² (adjusted)	.04	.07	.04	.07				

Note: ** indicates significance at 5 percent; * indicates significance at 10 percent. Standard errors are estimated by White's (1980) heteroskedasticity-consistent method. The dependent

variable is the natural log of real wage for the year ending at the 1987 interview. “Ability Controls” are the first two principal components of respondents’ age-adjusted ASVAB scores, and these two variables squared. All regressions include a constant, a variable indicating whether the respondent has any postsecondary schooling, and a variable indicating when the college characteristic was unavailable.

Table 2: College Characteristics in Wage Regressions
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Tuition (\$1,000s)	.029 (.055)	.030 (.055)	.036 (.053)						
Spending per Student (\$10,000s)				.053** (.018)	.057** (.018)	.057** (.017)			
Faculty/Student Ratio							1.88** (.723)	1.93** (.737)	1.91** (.707)
R² (adjusted)	.26	.26	.34	.26	.26	.34	.26	.26	.34

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Size (10,000s)	.017 (.013)	.018 (.013)	.023* (.012)						
Rejection Rate (ratio)				.240** (.115)	.248** (.107)	.248** (.103)			
1st Yr Retention Rate (ratio)							.387** (.127)	.388** (.124)	.374** (.120)
R² (adjusted)	.26	.26	.34	.26	.26	.34	.26	.26	.34

(Continues)

Table 2 (continued): College Characteristics in Wage Regressions
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Graduation Rate (ratio)	.211*	.226**	.244**						
	(.110)	(.108)	(.104)						
HS Top 10% (ratio)				.274**	.260**	.257**			
				(.117)	(.116)	(.111)			
SAT Interquartile Ratio (25th / 75th)							.719*	.715*	.594
							(.388)	(.367)	(.364)
R² (adjusted)	.26	.26	.35	.26	.26	.34	.26	.26	.34

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
College Major Controls	NO	NO	YES	YES		NO	NO	YES	YES
Industry Controls	NO	NO	YES	YES		NO	NO	YES	YES
Respondent's SAT	NO	YES	NO	YES		NO	YES	NO	YES
Average SAT (100s)	.032**	.031**	.035**	.034**					
	(.013)	(.013)	(.012)	(.012)					
75th Percentile SAT (100s)						.028*	.027*	.030*	.029*
						(.016)	(.016)	(.016)	(.015)
R² (adjusted)	.26	.26	.34	.34		.26	.26	.34	.34

(N=2,834)	(1)	(2)	(3)	(4)					
College Major Controls	NO	NO	YES	YES					
Industry Controls	NO	NO	YES	YES					
Respondent's SAT	NO	YES	NO	YES					
25th Percentile SAT (100s)	.033**	.031**	.032**	.031**					
	(.016)	(.016)	(.015)	(.015)					
R² (adjusted)	.26	.26	.34	.34					

(Continues)

Table 2 (continued): College Characteristics in Wage Regressions
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Faculty PhDs (ratio)	.276** (.099)	.296** (.099)	.277** (.097)						
Proportion Female (decimal)				-.312** (.123)	-.310** (.129)	-.335** (.128)			
2nd Quartile % Female							-.044 (.042)	-.044 (.045)	-.022 (.043)
3rd Quartile % Female							-.022 (.042)	-.022 (.040)	-.020 (.039)
Top Quartile % Female							-.090** (.043)	-.090** (.042)	-.078* (.041)
R² (adjusted)	.26	.26	.34	.26	.26	.34	.26	.26	.34

Note: ** indicates significance at 5 percent; * indicates significance at 10 percent. The covariance matrix is estimated by White's (1980) heteroskedasticity-consistent method. The dependent variable is the natural log of real wage for the year ending at the 1987 interview. All regressions include a constant, quartics in four variables—age, tenure, pre-college-graduation labor market experience, and post-graduation experience—controls for race, geographical region, urban residence, any postsecondary school completed, years of school completed, years of postsecondary school completed, receipt of a BA degree, and the ability controls described in

the text and Appendix. “College Major Controls” are the 24 basic college majors described in the Appendix; “Industry Controls” are the 15 industry indicators described in the Appendix; union status is included whenever industry controls are. “Respondent’s SAT” is their combined math and verbal score from 1981 and is only available for students in college that year. Missing values were set to zero, and a dummy variable was included to indicate missing values.

Table 3: College Characteristics in Wage Regressions
With Private School Indicator
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College Major Controls	NO	YES	NO	YES	NO	YES	NO	YES
Industry Controls	NO	NO	YES	YES	NO	NO	YES	YES
Tuition (\$1,000s)	.018** (.009)	.019** (.009)	.013 (.009)	.015 (.009)				
Private	-.135** (.060)	-.138** (.062)	-.086 (.061)	-.094 (.062)				
Spending per Student (\$10,000s)					.060** (.018)	.065** (.018)	.056** (.018)	.062** (.017)
Private					-.052 (.036)	-.056 (.036)	-.029 (.035)	-.032 (.036)
R² (adjusted)	.26	.26	.34	.34	.26	.26	.34	.34

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College Major Controls	NO	YES	NO	YES	NO	YES	NO	YES
Industry Controls	NO	NO	YES	YES	NO	NO	YES	YES
Size (10,000s)	.016 (.014)	.017 (.014)	.026 (.013)	.027 (.013)				
Private	-.007 (.039)	-.009 (.039)	.024 (.037)	.023 (.038)				
Faculty/Student Ratio					2.22** (.851)	2.31** (.788)	2.16** (.847)	2.30** (.780)
Private					.070 (.040)	.068 (.040)	.056 (.039)	.054 (.039)
R² (adjusted)	.26	.26	.34	.34	.29	.30	.35	.35

See note to Table 2.

Table 4: Percent Students Black in Wage Regressions
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834; 1,619; 760)	ALL MEN			WHITE MEN			BLACK MEN		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Fraction Black (decimal)	.452** (.214)	.422** (.211)	.333 (.207)	.353 (.248)	.371 (.250)	.332 (.267)	-.093 (.084)	-.057 (.079)	-.062 (.078)
Black x Fraction Black	-.551** (.229)	-.524** (.227)	-.453** (.221)						
Black	.074 (.054)	.067 (.053)	.027 (.052)						
R² (adjusted)	.26	.26	.34	.21	.22	.30	.29	.32	.37

(N=1,619; 760)	WHITE MEN			BLACK MEN		
	(4)	(5)	(6)	(7)	(8)	(9)
College Major Controls	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES
2nd Quartile % Black	.031 (.051)	.019 (.051)	.019 (.047)	-.002 (.090)	-.053 (.089)	-.013 (.090)
3rd Quartile % Black	.091 (.065)	.089 (.063)	.123** (.059)	-.046 (.100)	-.071 (.092)	-.061 (.089)
Highest Quartile % Black	.143** (.058)	.129** (.059)	.138** (.055)	-.106 (.075)	-.085 (.077)	-.080 (.073)
R² (adjusted)	.22	.22	.31	.29	.32	.39

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. Quartiles are mutually exclusive and are defined separately for whites and blacks. For white men, the 25th percentile school has a student body that is 2 percent black; the 50th percentile is 5 percent; the 75th percentile is 8 percent. For black men, the 25th, 50th, and 75th percentiles are

7, 16, and 83 percent, respectively. Mean percent students black is 14.3 overall; among white men, it is 6.5; among black men, it is 39.8. Hispanic and “other” respondents are excluded from the white and black samples. Substituting the more detailed college major controls (described in the Appendix) for the ones used here did not materially change the estimates.

Table 5: College Quality in Wage Regressions
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)
College Major Controls	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES
Quality Index	.038** (.011)	.038** (.011)	.036** (.010)			
Quality Quintiles						
2nd				.049 (.052)	.048 (.054)	.040 (.050)
3rd				.116* (.061)	.120** (.061)	.113* (.058)
4th				.143** (.058)	.148** (.059)	.149** (.057)
highest				.190** (.067)	.191** (.066)	.187** (.063)
R² (adjusted)	.26	.26	.34	.26	.26	.34

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. The standard deviation of the “Quality Index” is 1.95. “Quality Quintiles” are based on the Quality Index. Substituting the first principal component of spending per student and the student/faculty ratio for the Quality Index increases the size and standard error of the quality estimate slightly, but otherwise has little effect.

Table 6: College Quality and Background Characteristics
Basic Regressors Only
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Home Parents High School	YES	YES	YES	YES	YES	YES	YES	YES
Quality Index	.038** (.011)	.037** (.011)	.039** (.011)	.038** (.011)				
Quality Quintile								
2nd					.048 (.053)	.051 (.053)	.049 (.053)	.048 (.054)
3rd					.118* (.062)	.115* (.062)	.117* (.062)	.115* (.057)
4th					.141** (.058)	.142** (.154)	.143** (.058)	.137** (.057)
highest					.188** (.067)	.186** (.067)	.193** (.067)	.187** (.067)
R² (adjusted)	.26	.27	.26	.27	.26	.27	.26	.27

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. The “Basic Regressors” do not include college major or industry controls. Quality coefficient estimates from regressions including these controls are shown in the following tables. Substituting the first principal component of spending per student and the student/faculty ratio for the quality measure increases the size and standard error of the quality estimate slightly, but otherwise has little effect.

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. There are 81 “Detailed College Major Controls,” as described in the Appendix. Substituting the first principal component of spending per student and the student/faculty ratio for the quality measure increases the size and standard error of the quality estimate slightly, but otherwise has little effect.

Table 8: Percent Students Black, Controlling for Quality
Men 22-30
(heteroskedasticity-consistent standard errors in parentheses)

(N=2,834; 1,619; 760)	ALL MEN			WHITE MEN			BLACK MEN		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Background Controls	NO	NO	NO	NO	NO	NO	NO	NO	NO
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Quality Index	.038** (.011)	.038** (.011)	.036** (.010)	.027** (.013)	.027** (.013)	.026** (.012)	.073** (.029)	.057** (.028)	.057** (.029)
Fraction Black (decimal)	.472** (.214)	.440** (.211)	.350 (.216)	.367 (.248)	.361 (.246)	.328 (.265)	-.032 (.089)	-.018 (.082)	-.026 (.081)
Black x Fraction Black	-.546** (.227)	-.521** (.224)	-.449** (.229)						
Black	.080 (.053)	.074 (.052)	.034 (.050)						
R² (adjusted)	.26	.27	.34	.22	.22	.31	.30	.32	.39

(N=2,834; 1,619; 760)	ALL MEN			WHITE MEN			BLACK MEN		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Background Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Quality Index	.038** (.011)	.038** (.011)	.035** (.010)	.027** (.013)	.027** (.012)	.026** (.011)	.077** (.030)	.061** (.028)	.060** (.028)
Fraction Black (decimal)	.499** (.209)	.477** (.206)	.384* (.214)	.436* (.232)	.459** (.231)	.416* (.247)	-.051 (.091)	-.030 (.085)	-.029 (.084)
Black x Fraction Black	-.581** (.222)	-.565** (.220)	-.491** (.228)						
Black	.098* (.054)	.093* (.054)	.054 (.051)						
R² (adjusted)	.27	.27	.35	.22	.22	.31	.29	.32	.39

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. See the note to Table 4. Adding a private school indicator and Tuition to the regressions yields virtually identical estimates.

Table 9: Percent Students Black, Common Categories
Men 22-30
(heteroskedasticity-consistent standard errors in parentheses)

(N=2,834; 1,619; 760)	ALL MEN			WHITE MEN			BLACK MEN		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Background Controls	NO	NO	NO	NO	NO	NO	NO	NO	NO
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Quality Index	.035** (.011)	.035** (.011)	.032** (.010)	.024* (.013)	.023* (.013)	.021* (.012)	.073** (.030)	.054* (.028)	.054* (.029)
Percent Black:									
5%–7%	.112** (.042)	.117** (.042)	.112** (.039)	.037 (.048)	.045 (.047)	.056 (.043)	.194* (.100)	.175* (.101)	.171* (.094)
8%–17%	.146** (.045)	.151** (.044)	.165** (.042)	.126** (.056)	.130** (.055)	.152** (.052)	.090 (.090)	.055 (.089)	.079 (.085)
greater than 17%	.079 (.052)	.072 (.050)	.048 (.049)	.111 (.077)	.116 (.076)	.118 (.076)	.064 (.086)	.042 (.078)	.044 (.073)
R² (adjusted)	.27	.27	.35	.22	.22	.31	.30	.32	.39

(N=2,834; 1,619; 760)	ALL MEN			WHITE MEN			BLACK MEN		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Background Controls	YES	YES	YES	YES	YES	YES	YES	YES	YES
College Major Controls	NO	YES	YES	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES	NO	NO	YES
Quality Index	.034** (.011)	.034** (.011)	.030** (.010)	.024* (.013)	.024* (.012)	.021* (.011)	.077** (.031)	.059** (.028)	.057** (.029)
Percent Black:									
5%–7%	.105** (.043)	.111** (.042)	.105** (.040)	.030 (.048)	.038 (.047)	.046 (.044)	.231** (.103)	.227** (.102)	.192** (.095)
8%–17%	.146** (.045)	.153** (.044)	.167** (.042)	.125** (.056)	.132** (.055)	.153** (.052)	.081 (.091)	.068 (.092)	.082 (.087)
greater than 17%	.082 (.052)	.075 (.051)	.050 (.050)	.109 (.076)	.119 (.078)	.114 (.078)	.062 (.088)	.060 (.080)	.054 (.074)
R² (adjusted)	.27	.28	.35	.22	.22	.31	.30	.32	.39

See the notes to Table 2 and Table 4. The results are nearly identical when a private college control is included. The omitted first category includes 49 percent of the white men and 11 percent (21 men) of black men whose colleges report percent black. Twenty-four percent of

white men in the sample, and 15 percent of black men, attended colleges with 5 to 7 percent black students. Twenty-two percent of white men, and 25 percent of black men, attended colleges with between 8 and 17 percent black students. Five percent of white men (25 men), and 49 percent of black men attended colleges with greater than 17 percent black students.

Table 10: Race and College Quality Effects
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)
Background Controls	NO	NO	NO	YES	YES	YES
College Major Controls	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES
Quality Index	.029** (.012)	.029** (.012)	.026** (.012)	.028** (.012)	.028** (.012)	.025** (.012)
Black x Quality	.045 (.029)	.050* (.028)	.054* (.029)	.048* (.029)	.053* (.028)	.054* (.028)
Black	.001 (.024)	-.001 (.024)	-.026 (.023)	.007 (.026)	.007 (.025)	-.019 (.024)
R² (adjusted)	.26	.27	.34	.27	.27	.35

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2.

Table 11: Tuition, Size, Proportion Students Female
Controlling for Quality
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
College Major Controls	NO	YES	NO	YES	NO	YES	NO	YES
Industry Controls	NO	NO	YES	YES	NO	NO	YES	YES
Quality Index	.044** (.013)	.044** (.012)	.043** (.012)	.043** (.012)	.043** (.012)	.043** (.011)	.036** (.011)	.037** (.011)
Tuition (\$1,000s)	-.003 (.011)	-.001 (.011)	-.007 (.011)	-.006 (.011)				
Private	-.054 (.062)	-.061 (.063)	-.006 (.062)	-.016 (.063)				
Size (10,000s)					-.000 (.014)	.001 (.014)	.013 (.014)	.012 (.013)
Private					-.065 (.040)	-.065 (.040)	-.023 (.039)	-.026 (.040)
R² (adjusted)	.26	.27	.34	.34	.26	.27	.34	.34
.....								
(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Background Controls	NO	NO	YES	YES	NO	NO	YES	YES
College Major Controls	NO	YES	NO	YES	NO	YES	NO	YES
Industry Controls	NO	YES	NO	YES	NO	YES	NO	YES
Quality Index	.036** (.012)	.034** (.011)	.036** (.012)	.033** (.010)	.039** (.013)	.037** (.011)	.039** (.013)	.037** (.011)
Proportion Female (decimal)	-.177 (.124)	-.209* (.125)	-.162 (.125)	-.197 (.124)				
Proportion Female								
2nd quartile					.001 (.050)	.019 (.045)	.014 (.050)	.030 (.048)
3rd quartile					.044 (.044)	.036 (.041)	.047 (.044)	.039 (.041)
highest quartile					-.035 (.044)	-.041 (.042)	-.027 (.044)	-.032 (.042)
R² (adjusted)	.26	.34	.26	.34	.27	.35	.27	.35

See the note to Table 2. The estimates in the top panel do not change appreciably when background controls are added.

Table 12: College Quality and Wage Growth
(heteroskedasticity-consistent standard errors in parentheses)

<u>MEN 22–30 IN 1987</u>								
Equation 4								
Dependent Variable: Log Wage								
(N=2,395)								
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Background Controls	NO	NO	NO	NO	YES	YES	YES	YES
College Major Controls	NO	NO	YES	YES	NO	NO	YES	YES
Industry Controls	NO	NO	YES	YES	NO	NO	YES	YES
Quality Index	.031** (.011)	.023 (.021)	.029** (.010)	.026 (.020)	.030** (.011)	.021 (.021)	.028** (.011)	.026 (.020)
Quality × Experience (1,000s)		.126 (.286)		.043 (.263)		.132 (.287)		.051 (.263)
P-VALUE, JOINT SIGNIFICANCE OF QUALITY & INTERACTION		.02		.02		.03		.02
R² (adjusted)	.30	.30	.36	.36	.30	.30	.37	.36

Equation 5								
Dependent Variable: (lnW ₈₉ –lnW ₈₇)								
(N=2,395)								
	(1)	(2)	(3)	(4)				
Ability Controls	NO	NO	YES	YES				
Δ (Quality × Experience) (1,000s)	.022 (.103)	.030 (.102)	–.013 (.101)	–.008 (.099)				
Private		–.013 (.040)		–.008 (.040)				
R² (adjusted)	.07	.07	.07	.07				

Note: The dependent variable is natural log of real wage; the regressions are described in the note to Table 2. The sample is restricted to those who worked and had valid data in both 1987 and 1989. “Experience” in the interaction term is post-college experience.

Table 13: The Price of College Quality
(standard errors in parentheses)

Dependent
Variable: Tuition

Regressors
(N=1,289)

Quality Index	-1,774** (422.4)
Quality²	858.4** (128.9)
Quality³	-91.5** (14.9)
Quality⁴	2.94** (.569)
public	-5,012** (1,497)
public × Quality	429.8 (429.3)
public × Quality²	-56.8 (244)
public × Quality³	-55.3 (43.6)
public × Quality⁴	5.35** (2.38)
R² (adjusted)	.80

Note: The dependent variable is tuition (in-state tuition for public schools). The quality index is normalized so that its minimum value is zero. The regression is estimated using the full set of four-year colleges for which we have information. In addition to the variables shown, it also

includes a constant, quartics in size, proportion female, and percent black, and interactions between each of these variables and the public school indicator. Adding the quality variables increases R^2 by about .15.

Figure 1: Tuition and Quality

RELATIONSHIP FOR PRIVATE COLLEGES IMPLIED BY ESTIMATES IN TABLE 13

Quality has been normalized so that the smallest value is zero. The range in quality shown covers 90 percent of the colleges for which we can construct the quality index.

Table 14: Are the Quality Estimates Plausible?
(dollars)

	$\overline{\Delta w}$ (break-even)	Δw (quality effects)	
	(1)	(2)	(3)
Major & Industry Controls		NO	YES
Background Controls		NO	YES
Graduate in 4 years, r=.06:			
25th %ile to Median	\$240	\$766	\$705
Median to 75th %ile	\$420	\$1,000	\$921
Median to 95th %ile	\$1,550	\$4,450	\$4,070
Graduate in 4 years, r=.10:			
25th %ile to Median	\$440	\$766	\$705
Median to 75th %ile	\$780	\$1,000	\$921
Median to 95th %ile	\$2,880	\$4,450	\$4,070
Graduate in 5 years, r=.06:			
25th %ile to Median	\$310	\$766	\$705
Median to 75th %ile	\$540	\$1,000	\$921
Median to 95th %ile	\$2,000	\$4,450	\$4,070
Graduate in 5 years, r=.10:			
25th %ile to Median	\$580	\$766	\$705
Median to 75th %ile	\$1,030	\$1,000	\$921
Median to 95th %ile	\$3,800	\$4,450	\$4,070

Note: See Equation 6 on page 23. The break-even point in the first column is based on the estimated cost of quality at private colleges reported in Table 13. The quality effects are from estimates in Table 5 and Table A 13. They are evaluated at \$23,529, the average beginning salary offered Bachelor's degree recipients in Business in 1990 (Census 1994; Table 289). Quality effects (Δw) are linear in starting salary, so evaluation at the average beginning salary for graduates in the Humanities (\$23,213), Social

Sciences (\$21,627), or Computer Science (\$29,804) does not substantially change the result. The 25th, 50th, 75th and 95th percentiles of normalized quality are 2.08, 2.95, 4.05, and 7.42, respectively.

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Appendix

Table A 1 describes the basic set of regressors included in the log wage regressions. Table A 2 reports the results of the principal components analysis used to create the ability controls. Our ability controls were created in two steps. First, we created age-adjusted ASVAB scores by regressing each of the ten ASVAB scores for each individual on age dummy variables and an indicator of whether or not the respondent had completed high school when he took the ASVAB. The residuals from these regressions are the age-adjusted scores. These are the data for the principal components analysis. The first two principal components of the age-adjusted scores are the ability controls used in the wage regressions throughout the paper.

Table A 3 describes the family and other background variables included as controls in some of the regressions. Table A 4 describes the college characteristics we use as indicators of quality. Table A 5 reports descriptive statistics for the college characteristics. Table A 6 lists and describes our two sets of college major controls. Table A 16 and Table A 17 report the distributions of white and black men across schools, defined by the percent of students who are black.

Table A 1: Regressors for Log Wage Regressions

log wage	Log of average real wage (1982 dollars) on all jobs held during the year 1987 or 1989, as indicated
west, south, northeast	dummy variables indicating region of residence at the interview 1987 or 1989 interview, as indicated
smsa	dummy variable indicating that respondent lived in an SMSA at 1987 or 1989 interview, as indicated
union	indicates whether any job held during the year was covered by a collective bargaining agreement
age	respondent's age at the 1987 interview
experience	total months the respondent has been employed since age 16
tenure	total months the respondent has worked for the current employer
AA degree	dummy variable indicating the respondent has a 2-year college degree as of 1987 interview
BA degree	dummy variable indicating the respondent has a 4-year college degree as of 1987 interview (AA and BA are mutually exclusive; BA takes precedence over AA)
highest grade completed	highest grade or year of school the respondent completed as of the 1987 interview
black	dummy variable indicating the respondent is black
hispanic	dummy variable indicating the respondent is hispanic (black & hispanic are mutually exclusive)
AFQT score	Armed Forces Qualification Test, based on Armed Services Vocational Aptitude Battery, administered in 1980.
AFQT (not HS grad)	AFQT interacted with dummy variable indicating respondent had not completed high school when the AFQT was administered

Table A 2: Construction of Age-Adjusted Ability Measure
 Ability is First Two Principal Components of ASVAB Residuals

Component	Eigenvalue	Difference	Explained Proportion	Cumulative Explained
1	6.23577		0.6236	0.6236
2	1.23656	4.99921	0.1237	0.7472
3	0.58332	0.65324	0.0583	0.8056
4	0.48691	0.09641	0.0487	0.8543
5	0.31585	0.17106	0.0316	0.8858
6	0.29880	0.01784	0.0298	0.9156
7	0.23991	0.05809	0.0240	0.9396
8	0.23062	0.00929	0.0231	0.9627
9	0.19614	0.03448	0.0196	0.9823
10	0.17692	0.01922	0.0177	1.0000

Eigenvectors, 1st and 2nd Principal Components

	1st PC	2nd PC
general science residuals	0.34983	-0.15182
arithmetic reasoning residuals	0.34406	0.04834
word knowledge residuals	0.34782	0.04514
paragraph comprehension residuals	0.32261	0.15402
numerical operations residuals	0.27533	0.47801
coding speed residuals	0.24530	0.53074
auto and shop knowledge residuals	0.27982	-0.45859
mathematics knowledge residuals	0.32972	0.14300
mechanical comprehension residuals	0.32099	-0.32185
electrical information residuals	0.32887	-0.32301

Note: ASVAB scores are adjusted for age by regressing each test score on age dummy variables and a variable indicating whether the respondent had completed high school when the ASVAB was administered. Principal components analysis is performed on the OLS residuals from these

regressions. In all wage regressions, “ability controls” are the first two principal components and their squares. See Cawley, et al. (1995) on using the first two principal components.

Table A 3: Family Background & High School Controls

Home: magazine	“When you were about 14 years old, did you or anyone else living with you get magazines regularly?”
Home: newspaper	“When you were about 14 years old, did you or anyone else living with you get a newspaper regularly?”
Home: library card	“When you were about 14 years old, did you or anyone else living with have a library card?”
Parents: mom education	Highest grade or year of school completed by respondent’s mother.
Parents: mom living	Was the respondent’s mother living at the 1979 interview (when respondents were between 14 and 22 years old)?
Parents: mom age	At the 1987 interview.
Parents: dad education	Highest grade or year of school completed by respondent’s father.
Parents: dad living	Was the respondent’s father living at the 1979 interview?
Parents: dad age	At the 1987 interview.
Parents: living together	Indicator for whether the respondent’s mother and father lived in the same household at the 1979 interview.
Parents: mom occupation	Occupation of job held longest by mother or stepmother in 1978, represented by dummy variables for each Census 2-digit occupation.
Parents: dad occupation	Occupation of job held longest by father or stepfather in 1978, represented by dummy variables for each Census 2-digit occupation.
HS: Size	Asked of respondents’ high schools: “As of 10/1/79 [or nearest date] what was [your] total enrollment?”
HS: books	Asked of respondents’ high schools: “What is the approximate number of catalogued volumes in the school library (enter 0 if your school has no library).” [in 1979]
HS: teacher salary	Asked of respondents’ high schools: “What is the first step on an annual salary contract schedule for a beginning certified teacher with a bachelor’s degree?” [in 1979]
HS: disadvantaged	Asked of respondents’ high schools: “What percentage of the students in [the respondent’s high school] are classified as disadvantaged according to ESEA [or other] guidelines?” [in 1979]

Table A 4: College Characteristics Definitions

tuition	1990. For public schools, tuition is that for in-state residents.
acceptance rate	Percent of applicants accepted, fall 1990.
spending per student	Educational and general expenditures per full-time equivalent student, 1990.
1st year retention (%)	Average percent of 1987-89 freshmen who enrolled as sophomores.
graduation rate (%)	Average percent of 1983-85 freshmen who graduated within 5 years.
faculty/student ratio	Based on full-time equivalent total faculty and students, fall 1990.
size (# students)	1990.
% of faculty with Ph.D.	Percent of full-time faculty with doctorate or highest terminal degree.
% students black	Fall 1990.
% students female	1990
average SAT	Average SAT scores of fall 1990 freshmen.
25th %ile SAT	25th percentile of SAT scores of fall 1990 freshmen.
75th %ile SAT	75th percentile of SAT scores of fall 1990 freshmen.
25th / 75th %ile SAT	Ratio of 25th to 75th percentile SAT scores of fall 1990 freshmen.
HS top 10, HS top 25	Percent of fall 1990 freshmen who graduated in the top 10 or top 25 percent of their high school class.

Whenever a school quality measure appears, missing values are set to zero and a dummy variable indicating whether the quality measure is missing is included.

Table A 5: College Characteristics—Men
(unweighted)

	mean	25th %ile	median	75th %ile	N
tuition	\$3,600	\$1,450	\$1,900	\$5,060	838
rejection rate (%)	25	14	23	33	829
spending per student	\$12,290	\$7,280	\$9,690	\$14,720	821
1st year retention (%)	74	67	75	83	819
graduation rate (%)	44	31	44	55	764
faculty/student ratio	.066	.052	.059	.071	834
size (# students)	13,140	3,890	10,160	18,534	886
private college or university	.31	•	•	•	887
% of faculty with Ph.D.	74	62	77	87	817
% students black	14	3	5	10	797
% students female	52	48	53	57	886
average SAT	921	835	900	1,007	790
25th %ile SAT	824	740	839	1,040	524
75th %ile SAT	1,077	960	1,075	1,170	526
25th / 75th %ile SAT	.78	.75	.78	.81	524
HS top 10	27	12	21	34	574

Table A 6: College Major Controls

Agriculture (24) agriculture	chemical engineering civil engineering electrical engineering engineering technologies general engineering industrial engineering mechanical engineering misc. engineering
Architecture (11) architecture interior design misc. architecture	
Area Studies (1) area studies	
Biology (54) biochemistry biology microbiology pre-med zoology misc. biology	Fine Arts (58) art commercial arts drama design fine arts music performing music liberal arts studio arts misc. fine arts
Business (282) accounting banking and finance business administration economics international business institutional management marketing misc. business	Foreign Languages (14) french spanish misc. foreign language
Communications (45) advertising communications journalism radio & TV misc. Communications	Health Professions (159) nursing misc. health professions
Computer Science (41) computer science misc. computer science	Home Economics (16) home economics nutrition misc. home economics
Education (150) education	Interdisciplinary Studies (66) general studies liberal arts, & other interdisciplinary studies misc. other
Engineering (104) aerospace engineering	Law (11) law pre-law misc. law

Letters (25)

english
misc. letters

Mathematics (9)

applied mathematics
mathematics
misc. mathematics

Military (1)

military science

Office Occupations (53)

data processing
secretarial studies

(Continues)

Physical science (31)

chemistry
geology
physics
misc. physical sciences

Psychology (35)

psychology
misc. psychology

Public Service (46)

law enforcement
social work
misc. public service

Social Science (66)

anthropology
history
political Science
sociology
misc. social science

Theology (12)

theology

This table lists the two aggregations of college majors used. Respondents for whom there is no college major information have all of the indicator variables set to zero. Regressions that include college major controls also include a dummy variable indicating whether college major information was available for the respondent.

Detailed controls: The detailed measure recognizes 82 distinct college majors, listed above.

Basic controls: The 82 “detailed” college majors were aggregated into 24 areas. These are listed in boldface, with the number of respondents reporting a major in each of these categories given in parentheses.

Table A 7: College Characteristics in Wage Regressions

Men 22-30

(heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)
College Major Controls	NO	YES	YES
Industry Controls	NO	NO	YES
Tuition (\$10,000s)	-.097 (.078)	-.103 (.097)	-.090 (.078)
Spending per Student (\$10,000s)	-.045 (.039)	-.032 (.036)	.032 (.036)
Faculty/Student Ratio	2.66** (1.14)	2.53** (1.03)	2.47** (.101)
Size (10,000s)	-.003 (.017)	-.007 (.017)	.003 (.016)
Rejection Rate (ratio)	.128 (.125)	.147 (.119)	.130 (.115)
1st Yr Retention Rate (ratio)	.158 (.171)	.123 (.170)	.079 (.166)
Graduation Rate (ratio)	.014 (.169)	.042 (.166)	.113 (.163)
HS Top 10% (ratio)	.079 (.185)	.009 (.183)	-.005 (.176)
SAT Interquartile Ratio (25th / 75th)	-.428 (2.13)	-.828 (2.23)	-.606 (1.82)
Average SAT (100s)	-.013 (.022)	-.008 (.022)	-.005 (.021)
75th Percentile SAT (100s)	-.057 (.160)	-.059 (.147)	.058 (.139)
25th Percentile SAT (100s)	.078 (.202)	.079 (.185)	.078 (.174)
Faculty PhDs (ratio)	.192 (.125)	.228* (.126)	.150 (.125)
Fraction Female (decimal)	-.298** (.132)	-.291** (.138)	-.300** (.137)
R² (adjusted)	.26	.27	.34

The regressions are described in the note to Table 2.

Table A 8: Construction of Quality Index
Quality is 1st Principal Component

Component	Eigenvalue	Difference	Proportion Explained	Cumulative Explained
1	3.77657	2.84119	0.6294	0.6294
2	0.93538	0.26290	0.1559	0.7853
3	0.67248	0.41523	0.1121	0.8974
4	0.25725	0.01780	0.0429	0.9403
5	0.23946	0.12060	0.0399	0.9802
6	0.11886		0.0198	1.0000

Eigenvector, 1st Principal Component

spending per student	0.43209
faculty/student ratio	0.30544
rejection rate	0.32705
ave. SAT	0.45207
high school top25%	0.43904
high school top10%	0.46466

standard deviation of quality index: 1.94

Note: The quality index is the first principal component, constructed by multiplying each term in the 1st eigenvector by the corresponding variable. The variables were normalized for the principal components analysis.

Table A 9: Top 50 Colleges as Ranked by Quality Index

		Quality Index
1.	California Institute of Technology	11.20
2.	Johns Hopkins University (MD)	8.43
3.	Yale University (CT)	8.34
4.	Stanford University (CA)	8.27
5.	Massachusetts Institute of Technology	7.95
6.	Harvard University (MA)	7.41
7.	Princeton University (NJ)	7.20
8.	Columbia University (NY)	7.03
9.	Dartmouth College (NH)	7.01
10.	Washington University (MO)	6.99
11.	United States Air Force Academy (CO)	6.89
12.	Duke University (NC)	6.87
13.	Wake Forest University (NC)	6.55
14.	University of Chicago (IL)	6.43
15.	United States Military Academy (NY)	6.21
16.	University of Pennsylvania	5.94
17.	Cornell University (NY)	5.90
18.	Amherst College (MA)	5.88
19.	Rice University (TX)	5.75
20.	Pomona College (CA)	5.65
21.	United States Coast Guard Academy (CT)	5.57
22.	Williams College (MA)	5.56
23.	Cleveland Institute of Music (OH)	5.56
24.	Case Western Reserve University (OH)	5.55
25.	Harvey Mudd College (CA)	5.53
26.	Swarthmore College (PA)	5.51
27.	Northwestern University (IL)	5.45
28.	Bowdoin College (ME)	5.34
29.	Georgetown University (DC)	5.09
30.	Vanderbilt University (TN)	5.03
31.	Brown University (RI)	4.99
32.	Tufts University (MA)	4.67
33.	Wesleyan University (CT)	4.63
34.	University of California at Berkeley	4.62
35.	Wellesley College (MA)	4.59
36.	University of California at San Diego	4.50
37.	Haverford College (PA)	4.49
38.	University of Notre Dame (IN)	4.44
39.	University of Virginia	4.41

40.	University of Rochester (NY)	4.40
41.	Carnegie Mellon University (PA)	4.18
42.	Claremont McKenna College (CA)	4.15
43.	Carleton College (MN)	4.14
44.	Univ. of North Carolina at Chapel Hill	4.14
45.	Middlebury College (VT)	4.12
46.	Bryn Mawr College (PA)	4.07
47.	Emory University (GA)	4.02
48.	Vassar College (NY)	3.88
49.	Washington and Lee University (VA)	3.85
50.	New York University	3.80

Note: This list represents approximately the upper 9 percent of colleges for which we were able to construct our quality index (50 colleges represent about 4 percent of 4-year colleges). Because there appears to be a tendency for better colleges to report more data, “upper 9 percent” probably understates the relative quality of the colleges on this list compared to their position in the distribution of quality if we could calculate our quality index for all colleges.

Table A 10: First Two Quality Principal Components in Wage Regressions
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)
College Major Controls	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES
1st Principal Component (Quality Index)	.038** (.011)	.038** (.011)	.036** (.010)			
2nd Principal Component	-.008 (.028)	-.002 (.026)	-.000 (.026)	.011 (.029)	.018 (.027)	.019 (.026)
1st Principal Component Quintiles						
2nd				.075 (.053)	.072 (.055)	.066 (.051)
3rd				.147** (.064)	.150** (.064)	.146** (.060)
4th				.174** (.064)	.179** (.065)	.182** (.062)
highest				.221** (.068)	.222** (.066)	.220** (.063)
R² (adjusted)	.26	.27	.34	.26	.27	.34

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. The first principal component is the “quality index” used throughout the paper.

Table A 11: College Quality Interacted with Education Attainment Variables

Men 22-30

(heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)
College Major Controls	NO	NO	YES	YES
Industry Controls	NO	NO	YES	YES
Quality Index	.038** (.011)	.066** (.031)	.036** (.010)	.058** (.031)
Years of Post-HS Education (10s)	.044 (.110)	.037 (.110)	.106 (.111)	.092 (.110)
4-Yr Degree	.244** (.041)	.243** (.041)	.257** (.040)	.258** (.040)
Quality x Years of Post-HS Education (100s)	-.368	(1.01)	-.041	(1.08)
Quality x 4-Yr Degree		-.021 (.030)		-.036 (.030)
R² (adjusted)	.26	.26	.34	.34
sum of squared errors	511.356	510.921	449.249	448.664
degrees of freedom	2,800	2,798	2,760	2,758
p-value, F-Test of restricting interactions to 0	.31	.17		

Note: See notes to Table 2.

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. The college major controls are described in the text and the Appendix. Substituting the first principal component of spending per student and the student/faculty ratio for the quality measure increases the size and standard error of the quality estimate slightly, but otherwise has little effect.

Table A 13: College Quality and Background Characteristics
Industry Controls, College Major Controls and Basic Regressors
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Home Parents High School	YES	YES	YES	YES	YES	YES	YES	YES
Quality Index	.037** (.010)	.035** (.010)	.037** (.010)	.035** (.010)				
Quality Quintile								
2nd					.039 (.050)	.046 (.050)	.041 (.050)	.043 (.051)
3rd					.116** (.059)	.114* (.058)	.112* (.059)	.113* (.059)
4th					.147** (.057)	.146** (.056)	.147** (.056)	.141** (.056)
highest					.185** (.063)	.181** (.063)	.189** (.062)	.182** (.062)
R² (adjusted)	.35	.35	.35	.35	.34	.35	.34	.35

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. The college major controls are described in the text and the Appendix. The industry controls include union status. Substituting the first principal component of spending per student and the student/faculty ratio for the quality measure increases the size and standard error of the quality estimate slightly, but otherwise has little effect.

Table A 14: College Quality and Background Characteristics
Quality Index
 Men 22-30
 (heteroskedasticity-consistent standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Detailed College Major	NO	NO	NO	NO	YES	YES	YES	YES
Industry	NO	NO	NO	NO	YES	YES	YES	YES
QUALITY INDEX	.038** (.011)	.037** (.011)	.039** (.011)	.038** (.011)	.035** (.010)	.031** (.010)	.034** (.010)	.033** (.010)
HOME (JOINT SIG.)	(2%)			(9%)	(1%)			(12%)
magazine	.029 (.018)			.028 (.019)	.025 (.017)			.023 (.017)
newspaper	.034 (.021)			.023 (.021)	.033* (.019)			.019 (.019)
library card	.029 (.018)			.022 (.018)	.033* (.019)			.023 (.017)
PARENTS (JOINT SIG.)	(1%)		(1%)		(1%)		(7%)	
mom education (10s)		-.007 (.040)		-.017 (.041)		.028 (.037)		.018 (.037)
mom living		-.027 (.070)		-.034 (.069)		-.003 (.063)		-.011 (.062)
dad education (10s)		.042 (.031)		.036 (.031)		.035 (.030)		.030 (.030)
dad living		-.008 (.041)		-.003 (.041)		.001 (.038)		.006 (.038)
living together		-.027 (.069)		-.033 (.069)		-.033 (.059)		-.035 (.059)
mom occupation		YES		YES		YES		YES
dad occupation		YES		YES		YES		YES
HIGH SCHOOL (JOINT SIG.)			(2%)	(4%)			(1%)	(1%)
size (10,000s)			.237 (.146)	.193 (.147)			.335** (.137)	.282** (.137)
books (10,000s)			.006 (.012)	.004 (.012)			-.008 (.012)	-.008 (.011)
disadvantaged (decimal)			-.029 (.044)	-.011 (.044)			-.017 (.041)	-.002 (.041)
teacher salary (\$10,000s)			.174** (.080)	.186** (.081)			.193** (.077)	.206** (.077)
R² (adjusted)	.26	.27	.26	.27	.34	.36	.36	.36

Note: The dependent variable is log real wage; the regressions are described in the note to Table 2. The 81 detailed college major controls are described in the text and the Appendix. The “Home,” “Parents,” and “High School” variables are described in the Appendix. The covariance matrix is estimated using White’s (1980) heteroskedasticity-consistent method.

Table A 15: Cox Estimates
 Men 22-30
 (asymptotic standard errors in parentheses)

(N=2,834)	(1)	(2)	(3)	(4)	(5)	(6)
College Major Controls	NO	YES	YES	NO	YES	YES
Industry Controls	NO	NO	YES	NO	NO	YES
Quality Index	.085** (.022)	.088** (.023)	.100** (.010)			
Quality Quintiles						
2nd				.066 (.141)	.091 (.142)	.148 (.144)
3rd				.302** (.152)	.306** (.155)	.365** (.157)
4th				.390** (.139)	.408** (.140)	.494** (.141)
highest				.520** (.143)	.526** (.145)	.575** (.146)
log likelihood	-19,305	-19,289	-19,155	-19,304	-19,289	-19,154

Note: The Cox model produces estimates of hazard function parameters. To avoid confusion, the negative coefficient estimates, indicating that higher values of quality are associated with higher wages, are converted here to positive values.

Table A 16: Distribution of White Men Among Colleges, by Percent Students Black

	College's Percent Students Black	Number of White Men	Cumulative Percent of White Men
	0	1	0.19
	1	50	9.79
	2	83	25.72
	3	52	35.70
	4	70	49.14
	5	58	60.27
	6	32	66.41
	7	37	73.51
	8	29	79.08
	9	21	83.11
	10	16	86.18
	11	16	89.25
	12	4	90.02
	13	1	90.21
	14	9	91.94
	15	6	93.09
	16	3	93.67
	17	8	95.20
	18	3	95.78
	19	5	96.74
	21	1	96.93
	22	1	97.12
	23	1	97.31
	24	1	97.50
	25	4	98.27
	26	2	98.66
	31	2	99.04
	37	1	99.23
	38	1	99.42
	70	1	99.62
	84	1	99.81
	86	1	100.00
	Total	521	

Table A 17: Distribution of Black Men Among Colleges, by Percent Students Black

	College's Percent Students Black	Number of Black Men	Cumulative Percent of Black Men
	1	2	1.08
	2	2	2.16
	3	9	7.03
	4	8	11.35
	5	10	16.76
	6	9	21.62
	7	11	27.57
	8	5	30.27
	9	9	35.14
	10	4	37.30
	11	6	40.54
	12	2	41.62
	13	1	42.16
	14	3	43.78
	15	4	45.95
	16	10	51.35
	17	3	52.97
	19	1	53.51
	20	1	54.05
	23	2	55.14
	24	3	56.76
	25	8	61.08
	26	1	61.62
	37	1	62.16
	51	1	62.70
	59	1	63.24
	65	1	63.78
	72	1	64.32
	75	4	66.49
	78	3	68.11
	79	6	71.35
	82	2	72.43
	83	7	76.22
	84	6	79.46
	86	1	80.00
	88	1	80.54
	89	3	82.16
	90	1	82.70
	91	1	83.24
	93	9	88.11
	95	1	88.65
	96	4	90.81
	98	8	95.14
	99	9	100.00

TOTAL	185
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