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Does high school quality matter? Evidence from admissions data

Daniel Berkowitz, Mark Hoekstra*

Department of Economics, University of Pittsburgh, Pittsburgh, PA, United States

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ABSTRACT

This paper examines the effect of attending elite private high school on college placement using admissions data from the most selective high school in a large metropolitan area. To overcome omitted variable bias, we limit the sample to admitted applicants and control directly for the scores assigned by admissions based on in-depth analyses of the applicants and their families. In addition, we control for a wide set of covariates including student and family characteristics and entrance exam scores. Results indicate that attending selective private high school rather than other public and private high schools causes students to attend more selective universities. Effects are driven by gains for girls and students from lower-income neighborhoods.

1. Introduction

While there is widespread perception that school quality varies significantly, rigorously assessing whether some kinds of schools are more effective than others is difficult due to nonrandom selection into schools. The primary concern is that one of the many unobserved factors that determine whether a student attends a particular school will also affect outcomes after graduation. For example, while it is difficult to measure the extent to which a student's family is supportive of a highly rigorous education, this unobserved factor can influence the selection of high school as well as subsequent outcomes such as college quality and labor market performance. Thus, even with data sets containing rich measures of family demographics and student quality, estimates of the effect of attending selective schools may suffer from omitted variable bias.

In this paper, we address whether attending an elite private high school causes students to attend more selective colleges by utilizing an exceptional administrative data set from the most selective high school in a large metropolitan area. These data allow us to address omitted variable bias in three ways. First, we can estimate the effect of attending private school after conditioning on admission to the school, a factor rarely observed in most data sets. Thus, we can avoid the potential pitfalls associated with comparing students who attend selective private school with those rejected by the school.[1]

Second, we have acquired the actual scores assigned by the admission committee as a summary statistic for all student and family characteristics, including information on "difficult to quantify" characteristics such as student motivation and parental support. In short, we observe the exact information that to our knowledge has never been observed by the econometrician in this context, and would thus typically cause omitted variable bias. In addition, the data set also contains standard measures of family demographics and student quality employed in the literature including applicant race, gender, neighborhood income, grade point average, existing school type, and entrance

* Corresponding author.
E-mail addresses: dmberk@pitt.edu (D. Berkowitz), markhoek@pitt.edu (M. Hoekstra).

[1] By conditioning on admission to help overcome selection issues, our research design is most similar to Dale and Krueger (2002), who infer applicant quality using college admission decisions in order to estimate labor market returns to attending more selective private colleges.

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exam scores. Collectively, the richness of the data allows us to more convincingly estimate the causal effect of attending private school.

Third, we formally test for the presence of omitted variable bias using the methods proposed by Altonji, Elder, and Taber (2005). The results provide further support for our identification strategy: while we reject the null hypothesis of no omitted variable bias when using the full sample of applicants, we find no evidence of such bias once we condition on admission.

We find that attending an elite private high school has a statistically significant effect on the selectivity of the college later attended. Estimates imply that enrollees at the elite private school subsequently attend colleges and universities whose students have SAT scores that are 20 points higher on average,[2] which is approximately the difference between Oregon State and the University of Oregon, the University of Pittsburgh and Pennsylvania State, or Princeton and Harvard. These effects are driven largely by girls and students from lower-income neighborhoods. Importantly, recent estimates suggest that the economic gains to attending more selective universities can be significant. For example, Hoekstra (2009) reports that attending the flagship university increases earnings by 20% relative to attending college elsewhere.

2. Data

An anonymous independent elite high school provided the admission data. In return, we agreed not to reveal the school's identity. However, we can say that the school itself is a member of the National Association of Independent Schools, an organization representing more than 1300 schools nationwide.[3] The school is co-educational and has no religious affiliation. It is located in a nearby suburb of a major U.S. city, the metropolitan area of which ranks in the top 50 by population in the U.S.[4] Students are drawn primarily from the city and the suburbs near the school itself. Importantly for the purposes of this study, our perception from discussions with members of the education community was that this is the most selective private high school in the metropolitan area. For example, it is the only high school in the area ranked in the top 100 nationally based on the share of students placed at Harvard, Princeton, or Yale.[5] Thus, in our judgment, this school has considerably higher academic requirements and expectations for its students than, say, Catholic schools, which are those most frequently studied in the existing literature.

The admission data include information on applicants who applied for admission for the academic years of 1992–1993 to 2005–2006.[6] Applicants are primarily 8th graders who were attending other schools and thus had to apply in order to gain admission to the high school. For each student, we observe the type of middle school they were currently attending (public, parochial, or independent) as well as their race, gender, legacy status, and grade point average. In order to obtain a proxy for family income, we used applicants' home zip codes to link them to the median family income at the zip code level according to the 2000 Census.[7] In addition, we also observe the percentile ranking on the math and verbal sections of the Independent School Entrance Examination. This exam is perhaps best viewed as the middle school version of the SAT, and as such is considerably more rigorous than typical standardized tests taken by 8th graders.

Finally, we also observe the admission score assigned by the committee that the admission director subsequently used to determine admission.[8] This was the median score given by the members of the admission committee, which we normalized within application year to ensure comparability over time. Importantly, this score represents a summary statistic of the applicant strength based on important determinants of applicant quality that are typically unobserved by the econometrician. Each teacher on the committee would interview an applicant and ask the student, for example, to discuss a recent book that she had recently read or to describe her hobby. In addition, teachers on the committee reviewed written recommendations made on behalf of the applicant and read a sample of the applicants' writing and academic record. Often, a member of the committee would present the qualifications of an applicant to the rest of the committee. In addition, both the admissions director and committee often interviewed the parents in order to determine whether the applicant would have the family support necessary to succeed in an academically challenging environment.[9]

These data were then sent to the National Student Data Clearinghouse and linked to college records using date of birth and first and last name. This information includes the first full-time college enrollment between high school graduation and January of the following year. This provides a nearly complete picture of college decisions for these

[2] Methods developed by Altonji et al. (2005) show that these estimates are understated. Using their method, in fact, we can find that enrollees at elite private schools attend colleges and universities whose attendees have SAT scores that are roughly 40 points higher.

[3] See http://www.nais.org/.

[4] http://www.census.gov/population/www/cen2000/briefs/phc-t3/tables/tab03.txt.

[5] This comes from the highly cited issue of Worth Magazine (September 2002, pp. 94–104). See www.electricprint.com/edu4/classes/readings/edu-eliteschools.htm.

[6] Since we examine college enrollment as the primary outcome variable, we only use data on applicants who are observed for at least 8 months after high school graduation. Consequently, we use no applicants to the 9th and 10th-grade from 2005 to 2006 and no applicants to the 9th grade from 2004 to 2005.

[7] Given the families we observe have signaled interest in paying substantial tuition to send their child to a selective private school, we suspect that actual family incomes are systematically higher than the median neighborhood income.

[8] The general process was to admit enough applicants so as to reach the desired cohort size, though the admissions director did occasionally make exceptions and admit students with lower scores to meet desired gender ratios or address other goals. For example, if 75 slots were available and the admission director expected an enrollment rate of 75%, then he or she would admit the 100 students with the highest scores.

[9] The admission score contains information above and beyond that available through measures of demographics and other controls: a regression of admission score on all covariates except for enrollment implies that at most 55% of the variation in admission score is explained by the other measures of student and family quality.

applicants since the National Student Data Clearinghouse tracks enrollments at 92% of the nation's colleges and universities. However, applicants were not linked to college enrollment information if the applicant identifiers did not uniquely identify a student.[10]

The primary outcome used in this study is the selectivity of the college attended in the eight months following high school graduation.[11] The median SAT score of the college's entering freshmen class is used to measure selectivity.[12] These data were obtained from the National Center for Education Statistics (NCES) Integrated Postsecondary Education Data System (IPEDS). While this indicator of student success does not measure the outcome favored by labor economists (wages) or broader measures of success favored by the school's teachers and administrators,[13] it does measure an outcome of significant importance to parents. Moreover, there is increasing evidence that attending higher quality colleges causes subsequent success in the labor market (Behrman, Rozenzweig, and Taubman, 1996; Brewer, Eide, and Ehrenberg, 1999; Hoekstra, 2009).

Descriptive statistics for the applicants are contained in Table 1, where columns 1 and 2 show figures for all rejected applicants and for all admitted applicants. It is not surprising that admitted applicants have much higher GPAs and admission and entrance exam scores and come from higher-income neighborhoods. These differences highlight the potential difficulty in comparing admitted applicants to rejected applicants: given the significant differences in observed characteristics, one might reasonably wonder if the two populations also differ in ways unobserved to the econometrician. Furthermore, one might reasonably expect the differences to be even *more* stark if one were to compare admitted applicants to students who *did not apply* to the selective school. Thus, while we also observe that admitted applicants are subsequently more likely to be observed in college (72% versus 67%) and to attend much more selective colleges (i.e., where SAT scores for students average 1241 compared to 1103), one might well be skeptical that these differences are solely driven by whether a student went to a selective high school.

Consequently, to identify the effects of attending elite private school on college placement, we rely on the comparison of admitted applicants who attend the selective school to admitted applicants who attend high school elsewhere. Descriptive statistics for these two groups are shown in columns 3 and 4 of Table 1. In general, these two groups of applicants are much more similar to each other than are admitted and rejected applicants. Admitted students who attend the selective high school have marginally lower GPAs (3.41 versus 3.50) and a marginally lower percentile ranking in the entrance exam score (60.3% versus 62.5%). However, admitted students come from neighborhoods where family income is approximately $3500 higher[14] and they are much more likely to be legacies (40% versus 18%).[15] There appears to be little difference in college-attendance (71% versus 73%),[16] which is consistent with what one would expect for students admitted to a selective high school. While these rates could, in theory, reflect the possibility that not all admitted applicants attend college, the evidence suggests this is unlikely. Among the top quintile of applicants by admission score, only 68% are observed with college records. Since these students are almost certainly college-bound, this suggests that records for approximately 30% of the sample cannot be identified uniquely using first and last name and date of birth. This has important implications for our study, as it suggests that there is unlikely to be any systematic difference between admitted applicants observed and not observed with college records.

Finally, students who attend the selective private high school and are subsequently observed with college records attend colleges where the median SAT score of the entering freshmen class was 1243 out of 1600. Thus, the average enrollee attended universities like the University of Florida, Pepperdine University, Gettysburg College, and the University of Illinois at Urbana-Champaign.

Since our main outcome of interest is the selectivity of college subsequently attended and since some students were not observed with college records since they were not uniquely identified with first and last name and date of birth, in columns 5 and 6 of Table 1 we show descriptive statistics for admitted students linked to a college after graduation. There is little to no difference between admitted applicants subsequently linked to college records and those not. This suggests that the reason we only observe around 70% of applicants with college records is in fact due to the uniqueness problem with the matching, rather than to the possibility that admitted applicants do not subsequently enroll in college.[17]

[10] For example, a high school applicant named John Doe who was born on January 1, 1980, who did attend college would not be observed in our data if the National Student Data Clearinghouse had records of two or more different individuals named John Doe born on that same date.

[11] We also attempted to acquire data on applicant SAT scores from the College Board, but were unable to do so due to the cost of the data (the College Board charges on a per-year basis) and restrictions on what they were willing to provide.

[12] This was computed as the midpoint of the 25th and 75th percentiles. We were unable to link SAT scores to colleges attended by 12 applicants in our data. Consequently, for these colleges we assigned the average selectivity score of the colleges in our data that received the same Barron's ranking.

[13] The school president, admissions director, and one teacher with whom we spoke stated that they are most concerned with whether their graduates distinguish themselves in important, though not necessarily lucrative, fields such as the arts, education, government, and social entrepreneurship, as well as whether the student was subsequently involved in philanthropic endeavors. We leave the question of the effects of private schooling on such outcomes to future research.

[14] The differences in GPA and neighborhood income are both significant at the 1% level, while the p-value for the difference in entrance exam scores is 10.9%.

[15] To deal with these differences we will explicitly control for the neighborhood income and whether or not a student is a legacy in our formal empirical analysis.

[16] Recall that we only observe college attendance for students uniquely linked to college records on the basis of first name, last name, and date of birth.

[17] In results not shown, we have also estimated effects after imputing college selectivity for admitted students not observed with college records. We imputed college selectivity using all covariates from the main estimating equation except for the indicator for whether the student enrolled at the elite private high school. Estimates of the enrollment

Table 1
Summary statistics.

	All applicants		Admitted applicants		Admitted applicants linked to college	
	Rejected	Admitted	Attend	Don't attend	Attend	Don't attend
	1	2	3	4	5	6
Admitted	0.00	1.00	1.00	1.00	1.00	1.00
Enrolled	0.00	0.63	1.00	0.00	1.00	0.00
Matched to college	0.67	0.72	0.71	0.73	1.00	1.00
College selectivity if matched (median SAT)	1103	1241	1243	1238	1243	1238
	(115)	(125)	(116)	(138)	(116)	(138)
Grade of potential high school entry	9.57	9.27	9.24	9.32	9.24	9.31
	(0.77)	(0.59)	(0.56)	(0.29)	(0.56)	(0.62)
Admission score (normalized)	−1.53	0.31	0.32	0.29	0.30	0.29
	(0.78)	(0.70)	(0.72)	(0.64)	(0.71)	0.62
Male	0.66	0.39	0.37	0.41	0.39	0.39
Median neighborhood income (in 2000 dollars)	$53,140	$58,183	$59,533	$55,894	$59,332	$56,924
	($17,297)	($17,963)	($18,299)	($17,156)	($18,071)	($17,245)
Race						
White	0.70	0.78	0.76	0.80	0.79	0.83
Black	0.23	0.07	0.06	0.08	0.06	0.07
Asian	0.07	0.14	0.16	0.11	0.14	0.08
Other race	0.00	0.02	0.02	0.02	0.01	0.02
Middle school GPA	2.68	3.46	3.41	3.50	3.40	3.51
	(0.67)	(0.46)	(0.47)	(0.44)	(0.49)	(0.43)
High school entrance exam percentile ranking	32.7	61.0	60.3	62.5	59.2	61.0
	(21.3)	(21.8)	(21.5)	(22.3)	(20.9)	(22.0)
Middle school type						
Public	0.51	0.41	0.42	0.39	0.41	0.38
Independent	0.25	0.38	0.37	0.40	0.36	0.38
Religious	0.24	0.21	0.21	0.21	0.23	0.24
Legacy	0.18	0.32	0.40	0.18	0.38	0.19
Observations	267	1321	829	492	591	359

Reported in each cell is the mean, while standard deviations are in parentheses.

3. Identification strategy and methodology

In general, researchers have used one of two methods for tackling the selection problems plaguing estimates of attending private schools. The first is to employ instrumental variables methods to examine the effect of attending private school on test scores, high school completion, and college attendance.[18] However, the validity of these instruments has been questioned by Altonji, Elder, and Taber (2002). This criticism reflects the general difficulty of finding instruments that are both "strong" and satisfy the exclusion restriction (see Berkowitz, Caner and Fang, 2009; Conley, Hansen and Rossi, 2007; and Kraay, 2008). More recently, researchers have exploited discontinuities created by admission rules to examine the impact of attending selective schools on university enrollment in the United Kingdom (Clark, 2010), or of attending selective universities on earnings in the United States and Colombia (Hoekstra, 2009; Saavedra, 2009). While our data would be well-suited for such a regression discontinuity analysis, unfortunately a relatively small sample size and the corresponding lack of statistical power make the estimates so imprecise as to make them uninformative.[19]

A second solution is to assume that students select into private schools only on the basis of observable characteristics, a solution only as effective as the data set used.[20] In most applications—including returns to private schooling—it is unlikely that the econometrician observes the factors that determine both treatment (enrollment at the private school) as well as subsequent success. This problem is likely to be particularly severe in the context of *selective* private schools. Consequently, a related approach is to infer unobserved student quality from information on an individual's admission decisions at various schools. This approach was implemented by Dale and Krueger (2002), who identify the impact of attending selective colleges on earnings by comparing the outcomes of individuals who attended more selective schools to those who were admitted to similarly selective schools, but attended less selective schools.

We implement an identification strategy similar to Dale and Krueger (2002) in that we compare students who enrolled at the private high school to those who were admitted by the private school, but attended high school elsewhere. However, we extend this research design by additionally controlling for the continuous score given by the admission committee. Importantly, the information contained in this score is largely unexplained by the other covariates; estimates indicate that at most 55% of the variation in the admission score can be explained with the other measures available to the admissions committee such as GPA and entrance exam scores.[21] This suggests that the admission score likely contains additional information relevant for predicting post-high school outcomes.

To formally test whether attending the elite private high school impacts college enrollment and selectivity, we estimate two versions of the following equation for admitted students using ordinary least squares:

$$\begin{aligned} Outcome_i = {} & \beta_0 + \beta_1 X_i + \beta_2 MiddleSchGPA_i + \beta_3 Legacy_i \\ & + \beta_4 EntranceExam_i + \beta_5 AdmissionScore_i \\ & + \beta_6 AttendedEliteHS_i + \varepsilon_i \end{aligned}$$

In the first version of the estimating equation, $Outcome_i$ measures whether student i is observed to have enrolled in college; in the second version $Outcome_i$ is the median SAT score of the entering class at the college subsequently attended. The vector of controls is given by X, which includes neighborhood (i.e., zip code) income, race and gender fixed effects, application year and grade of application fixed effects, and middle school fixed effects (religious, public, or independent). The variable *MiddleSchGPA* captures the applicant's grade point average at the middle school, *Legacy* is equal to one if the applicant had family or siblings who had attended the elite private school, *EntranceExam* captures the percentile ranking of students on the verbal and quantitative sections of the Independent School Entrance Exam, and *AdmissionScore* captures the score given to the admission committee after reviewing all of this information and much more. We control for quadratic functions of all continuous control variables to allow for nonlinearities. In addition, since not all students were observed with all covariates, indicators for missing variables were also included.[22]

The coefficient of interest is β_6, which captures the effect of enrolling at the selective private school. The interpretation of this estimate depends on the nature of the counterfactual. While we do not observe the high school of applicants who did not attend this particular high school, discussions with the admissions director suggest that most stayed in the same school system attended during middle school. Assuming that this is the case, 39% of students who enrolled elsewhere attended public high school, 21%

effect are 15.2 and 12.8 SAT points, both of which are significant at the 5% level and correspond to estimates of 19.9 and 18.2 SAT points presented in columns 5 and 6 of Table 4.

[18] For example, Evans and Schwab (1995), Neal (1997), Sander (1996), and Sander and Krautmann (1995) use instruments capturing religious affiliation or proximity to schools to estimate the effect of attending Catholic schools on test scores and college attendance. Also, see Figlio and Stone (1999).

[19] While we estimate that there is a discontinuous increase in enrollment of 15–20 percentage points at the admission cutoff, the standard error for the (unweighted) RD estimate on college selectivity is three times as large as that for the OLS estimates. This results in an uninformative 95% confidence interval of [−19, 83] SAT points. Reweighting the coefficient and standard errors to adjust for the relatively small 15% point increase in enrollment yields even less informative estimates.

[20] Jepsen (2003) uses this strategy to investigate the effect of attending Catholic school.

[21] See footnote 9.

[22] Of the 950 admitted applicants in our data linked to colleges, neighborhood income was missing for 3 students, race was missing for 152 students, middle school GPA was missing for 288 students, entrance exam scores were missing for 176 students, school type (e.g., public, independent, religious) was missing for 64 students, and legacy status was missing for 1 student.

Table 2
The effect of elite private high school on college attendance.

Sample	All applicants		Only admitted applicants	
	1	2	3	4
Enrollment effect on attending college	0.00	−0.01	−0.02	−0.01
	(0.03)	(0.03)	(0.03)	(0.03)
Observations	1588	1588	1321	1321
Controls for student and family characteristics	Yes	Yes	Yes	Yes
Controls for admission score	No	Yes	No	Yes

Notes: Each column represents a separate regression of college selectivity on enrollment at the elite school and other controls. Robust standard errors are in parentheses. Student and family characteristics include math and verbal admission test scores, legacy status, GPA, neighborhood income, and indicators for race, sex, middle school type, application year, and application grade.

Table 3
Subgroup analysis: the effect of elite private high school on college attendance.

Sample	All admitted students	Boys only	Girls only	High-income families	Lower-income families
	1	2	3	4	5
Enrollment effect on attending college	−0.01	0.01	−0.04	−0.06	0.04
	(0.03)	(0.05)	(0.04)	(0.04)	(0.05)
Observations	1321	512	809	660	656
Controls for student and family characteristics	Yes	Yes	Yes	Yes	Yes
Controls for admission score	Yes	Yes	Yes	Yes	Yes

Notes: Each sample only includes admitted applicants. Each column represents a separate regression of college selectivity on enrollment at the elite school and other controls. Robust standard errors are in parentheses. Student and family characteristics include math and verbal admission test scores, legacy status, GPA, neighborhood income, and indicators for race, sex, middle school type, application year, and application grade.

attended religious high schools, and 40% attended other independent high schools.[23,24]

4. Results

4.1. The effect of attending a selective private high school on college attendance

We first examine whether attending an elite private high school affects the likelihood that a student is enrolled in college within eight months after graduating from high school. Results are shown in Table 2, where the first two columns contain results for the full sample of applicants (those who were admitted as well as those who were rejected) and subsequent columns contain findings for the set of students who were admitted. Column 1 shows results from a specification with all controls except for admission score, and column 2 additionally controls for admission score.

Results indicate there is little evidence that attending the selective high school affects college attendance. Results remain unchanged when the sample is restricted to only admitted applicants, as shown in columns 3 and 4, for which the estimates remain small and statistically insignificant.

In Table 3 we investigate whether attending the selective high school affects college attendance differently by gender or neighborhood income. Results for admitted applicants are presented in columns 1–5 of Table 3, which show estimates for all applicants, boys, girls, students from higher-income neighborhoods, and students from lower-income neighborhoods. None of the estimates are statistically significant at conventional levels.

In summary, we find little evidence that enrolling at the selective school affects the likelihood that students will subsequently enroll in college. While this comes as little surprise given that applying to this school signals both high student ability and high parental valuation of education, it does mean that estimates of the effect on college selectivity should be unaffected by selection into college attendance.

4.2. The effect of attending elite private high school on college selectivity

We now turn to whether attending the elite private high school affects the selectivity of the college subsequently attended, as measured by the median SAT score of the entering class of the college. Table 4 takes the same form as Table 2, where columns 1 and 2 contain estimates for all applicants, while columns 3 and 4 show estimates for only admitted applicants. In addition, below each estimate we report the *t*-statistic for the test proposed by Altonji et al. (2005), where the null hypothesis is that there is no omitted variable bias. This method uses the correlation between the treatment (whether or not a student enrolls) and all other observables in order to gauge the correlation between the treatment and the stochastic error term. Thus, this test relies on the somewhat conservative assumption that selection on unobservables is similar to selection on observables, and allows one to compute estimates of omitted variable bias and the associated standard errors.[25]

[23] If anything, this probably understates the extent to which these students attended other private schools since their application suggests that they were clearly interested in doing so.

[24] In unreported results, we find the effects of attending the elite private school on college selectivity are largest for students coming from religious middle schools, though the effect is not statistically distinguishable from the effects for students from public and private middle schools.

[25] We thank Todd Elder for patiently explaining how this method works and how it can be implemented.

Table 4
The effect of attending elite private high school on college selectivity.

Sample	All applicants		Only admitted applicants	
	1	2	3	4
Enrollment effect on college selectivity	25.54***	19.14**	19.88**	18.26**
	(8.52)	(8.49)	(9.21)	(9.17)
Observations	1130	1130	950	950
Controls for student and family characteristics	Yes	Yes	Yes	Yes
Controls for admission score	No	Yes	No	Yes
Omitted variable bias *t*-statistic	6.08	6.89	−1.56	−1.32
Reject null hypothesis of no omitted variable bias?	Yes (biased upward)	Yes (biased upward)	No	No

Notes: Each column represents a separate regression of college selectivity on enrollment at the elite school and other controls. Robust standard errors are in parentheses. Student and family characteristics include math and verbal admission test scores, legacy status, GPA, neighborhood income, and indicators for race, sex, middle school type, application year, and application grade. The omitted variable test statistic is from the test proposed by Altonji et al. (2005), where the null hypothesis is that there is no omitted variable bias.

** Significant at the 5% level.

*** Significant at the 1% level.

Table 5
Subgroup analysis: the effect of attending elite private high school on college selectivity.

Sample	All admitted students 1	Boys only 2	Girls only 3	High-income families 4	Lower-income families 5
Enrollment effect on college selectivity	18.26**	8.12	26.06**	7.62	29.86**
	(9.17)	(15.10)	(11.83)	(12.72)	(14.23)
Observations	950	371	579	486	461
Controls for student and family characteristics	Yes	Yes	Yes	Yes	Yes
Controls for admission score	Yes	Yes	Yes	Yes	Yes
Omitted variable bias *t*-statistic	−1.32	−2.29	0.37	−1.85	−0.30
Reject null hypothesis of no omitted variable bias?	No	Yes (biased downward)	No	Yes (biased downward)	No

Notes: Each sample only includes admitted applicants. Each column represents a separate regression of college selectivity on enrollment at the elite school and other controls. Robust standard errors are in parentheses. Student and family characteristics include math and verbal admission test scores, legacy status, GPA, neighborhood income, and indicators for race, sex, middle school type, application year, and application grade. The omitted variable test statistic is from the test proposed by Altonji et al. (2005), where the null hypothesis is that there is no omitted variable bias.
**Significant at the 5% level.

As shown in column 1, the estimated difference in college selectivity for the full sample of applicants is 25 SAT points, while additionally controlling for admission score in column 2 reduces the estimate to 19 points. However, the results of the Altonji et al. (2005) omitted variable test suggest that one cannot rule out that the positive effects found are due entirely to omitted variable bias. Specifically, we can resoundingly reject the null hypothesis of no omitted variable bias ($t = 6.9$), finding instead that the estimates are significantly *overestimated*. This highlights the difficulty in ruling out omitted variable bias when comparing outcomes of two groups that differ so considerably on observable characteristics.

Consequently, we next move to our preferred identification strategy, which relies on comparing admitted applicants who attend the selective school to admitted applicants who attend elsewhere. Estimates are shown in columns 3 and 4 of Table 4. Results indicate that the effect of attending the private school is approximately 18–20 SAT points, which is statistically significant at the 5% level. Furthermore, we cannot reject the null hypothesis of no omitted variable bias for the specification in either column, and the sign of the omitted variable bias suggests that if anything, our estimates understate the true effect. Specifically, bias-corrected estimates for columns 3 and 4 are 41.7 (se = 16.8) and 36.1 (se = 16.3) SAT points, respectively.[26]

We also investigate whether the effects vary by gender or family income. Estimates are shown in Table 5. Results indicate that the effect of attending the selective high school works largely through significant positive effects for girls (26 SAT points) and students from lower-income families (29 SAT points).

The effect for lower-income students may be larger for several reasons. On the one hand, students from lower-income families may benefit more because the quality difference between the elite private school and their next-best alternative is larger than for their higher-income peers. Alternatively, lower-income students may benefit more if they are less able to substitute family inputs for school inputs.

It is less obvious why girls might benefit more than boys. Given the results for low- and high-income families, one might wonder whether girls benefit because they may come from systematically lower-income neighborhoods. This does not appear to be the case; in unreported results,

[26] Standard errors are computed assuming independence.

we find that both low- and high-income girls experience statistically significant positive effects. This suggests that the positive overall effect is not driven entirely by students who have lower quality next-best alternatives, and that women gain for some other reason. For example, women could benefit more from the elite school than men if the total returns to attending an elite college are greater for women, or if elite schools empower women more than traditional public schools.

In contrast, we find little evidence that boys or students from higher-income families attend more selective universities due to attending the selective high school. We note, however, that the Altonji et al. (2005) test indicates that we have *underestimated* the effects for both subgroups, which would suggest that the subgroup differences observed in Table 5 could be overstated. For example, assuming selection on unobservables is similar to selection on observables produces bias-adjusted estimates of 54.1 (se = 25.1) and 40.7 (se = 21.9) SAT points for boys and higher-income students, respectively.

In summary, our study yields two important findings. First, we find that attending a highly selective private high school rather than other top public and private schools causes students to attend more selective colleges. In addition, we find that this effect is largely driven by gains for girls and students from lower-income families.

5. Conclusions

Understanding the extent to which school quality impacts subsequent outcomes is of interest to parents and students as well as to policymakers. However, as is the case with many interesting questions in economics, it is difficult to disentangle the effect of school quality from the selection effects associated with attending different types of schools. This problem is likely to be particularly severe for assessing school quality at the top end of the school/student ability distribution, where students must first gain admission based on characteristics not typically observed by the econometrician.

In this paper, we address this question by exploiting a unique administrative data set obtained from the most selective high school in a large metropolitan area. The data enable us to do two important things to overcome the identification problem associated with estimating returns to selective schooling. First, we can condition on admission to the selective school in a way similar to Dale and Krueger (2002). Thus, we avoid comparing the outcomes of students who attend a highly selective school to those rejected by the school, a decision at least partly based on factors not typically observed by researchers. In addition, we can also control directly for the score assigned to each applicant by the school, a measure rarely if ever available in other data sets.

Results indicate that attending the elite private high school causes students to subsequently attend more selective colleges and universities. Specifically, we find that enrolling at the selective high school causes students to enroll at colleges where the median SAT score of the entering class is 20 points higher. This effect is relative to attending other top public and private high schools in the area and is approximately the difference between attending Oregon rather than Oregon State, Pennsylvania State rather than the University of Pittsburgh, or Harvard rather than Princeton. We find no evidence that our estimates are due to omitted variable bias using the methods of Altonji et al. (2005), finding instead that if anything, our estimates are somewhat understated. Furthermore, our results indicate that this effect is driven largely by gains for girls and children from low-income families.

While the effects are not extremely large, recent evidence suggests that attending more selective universities can lead to significant increases in earnings, at least for some subgroups. For example, Dale and Krueger (2002) find that among students attending highly selective private colleges, attending more selective colleges increases earnings for students from low-income families, though it has no effect on the earnings of other students. Brewer et al. (1999) find significant returns to attending elite private institutions for all students, while Behrman et al. (1996) report evidence of a positive payoff from attending Ph.D.-granting private institutions with well-paid faculty. Hoekstra (2009) finds that enrolling at the flagship state university increases earnings by approximately 20%. While the difference in the quality of the flagship relative to the alternative options was greater in the case of Hoekstra (2009) than the effect estimated here, scaling the earning estimates suggests that attending a highly selective private high school would still increase earnings by 5%.[27] Thus, our results suggest that differences in school quality may be important across the distribution of schools, rather than only for students attending failing schools.

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[27] Hoekstra (2009) reports that the 2nd- and 3rd-most selective state universities in that study ranked 65 and 83 SAT points lower than the flagship, respectively. Thus, the effect of 18 SAT points presented here is approximately 24% of the difference between the flagship and those two schools, implying that the rescaled difference in earnings would be 24% × 20% = 5%.

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