ABILITY SORTING AND THE IMPORTANCE OF COLLEGE QUALITY TO STUDENT ACHIEVEMENT: EVIDENCE FROM COMMUNITY COLLEGES

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Abstract
This article examines the effect of institutional quality on the educational attainment of community college students, a large group that has been mostly overlooked in previous work. The effect of institutional quality is generally difficult to separate from that of student ability because more capable students usually sort into better colleges. A detailed analysis of student sorting reveals this not to be the case among community college students, for whom college quality is effectively determined by factors other than their aptitude. This facilitates identification of school quality effects. I find that community college quality (as measured by instructional expenditure per student and several other measures) has no impact on community college students' educational attainment. States and colleges should seek to identify other factors that may be more influential.

1. INTRODUCTION

Highlighting the considerable variety of U.S. colleges, a recent economics literature has examined the labor market consequences of attending colleges of differing quality, where quality is typically measured by institutional resources or average student aptitude (selectivity).[1] The general finding from this body of work is that college quality has a positive effect on earnings. This finding has obvious importance for students deciding whether to attend a higher-quality college, since these are typically more expensive. Colleges themselves are also under increased pressure to find ways to improve student outcomes, as mandated accountability measures have become commonplace in most realms of education.[2]

This article examines the role of community college quality in BA-seeking students' success at earning BA degrees. Community colleges serve a diversity of students with a wide variety of educational offerings (including academic, vocational/technical, adult, continuing, and developmental) and also act as social and cultural hubs for their communities (Cohen and Brawer 2008). However, preparing recent high school graduates for upper-division standing—as most BA-granting institutions also do—has been a core part of community colleges' mission since their beginning. Does college quality influence degree attainment among community college students seeking a bachelor's degree? The previous literature has been silent on this question. Though enrollment at community colleges exceeds that of private four-year colleges and nearly equals that of public four-year colleges (USDOE 2007), the sector has been mostly overlooked by previous research on college quality. Previous work has also focused on post-schooling labor market outcomes rather than schooling completion itself. Stagnation in the rate of college graduation despite the high returns to completing a four-year degree (Turner 2004; Bound, Lovenheim, and Turner 2010) has partially shifted attention from college access to completion as a target for educational policy (see Hoxby 2004). The college quality literature does not currently reflect this perspective. This article also carefully assesses the issues of selection bias and quality measurement in the community college context. A key finding is that better BA-seeking students do not sort into higher-quality community colleges, in striking contrast to the four-year college sector. These important differences between the four-year and two-year sectors have not been fully appreciated in previous analysis of the latter.

1. For the most recent overview, see Black and Smith (2004, 2006) and Long (2008).
2. Accountability measures are required by the No Child Left Behind Act of 2001 (public K–12 schools), the Workforce Investment Act of 1998 (public job training programs), and the Student Right-to-Know Act of 1990 (postsecondary schooling). The latter requires colleges to publicize graduation rates.

Though the adverse effects of starting at a community college (rather than at a four-year school) have been widely studied, the institutional characteristics that mediate this relationship have not.[3] One exception is Calcagno et al. (2008), who examine the effect of institutional characteristics (size, resources, location, student body) on whether community college students have any type of positive outcome (certificate, Associate of Arts (AA), BA, transfer). They find that larger size, more part-time faculty, and more minority students are negatively related to these outcomes, but expenditures are generally not. Interpretation is one limitation of their study: students with a broad range of educational aspirations and many different outcomes are combined, so the estimated effect is not directly comparable to the previous literature on (four-year) college quality.[4]

I use instructional expenditure per student—an aspect of quality directly controlled by policy makers—as my primary measure of community college quality. Per student instructional expenditure is highly correlated with measures of four-year college quality used in the previous literature and is available for community colleges, while previous measures are not. I find that higher per student instructional expenditure does not increase students' likelihood of earning a bachelor's degree, nor does it increase years of schooling or the likelihood of transferring to a four-year school. Alternative measures of college quality (faculty salary and characteristics, characteristics of peer students, and indexes constructed from several measures) yield qualitatively similar results. I find no evidence to suggest that this pattern is driven by adverse student selection offsetting positive effects.

This finding stands in contrast with the generally positive college quality effects found at four-year colleges (e.g., Long 2008) but is more consistent with work suggesting that greater resources alone do not improve student achievement in the K–12 context (e.g., Hanushek 2006). One possible interpretation is that local community colleges face little competition for transfer students and thus have little incentive to use resources effectively for that purpose, given their other competing functions. In their sweeping overview and history of the sector, Cohen and Brawer (2008) identify five primary functions of almost all community colleges: academic transfer, vocational/technical education, continuing education, developmental education, and community service. While this multifaceted function is often celebrated, multiple missions may also spread resources too thin. Consequently, increases in funding alone will not necessarily lead to better outcomes for

3. See Long and Kurlaender (2009) for an extensive recent and multi-method analysis of the effect of starting at a community college and for a review of previous work on the subject.
4. For instance, their analysis does not determine whether certain institutional characteristics shift students to "worse" outcomes, such as from a BA to an AA degree.

transfer students. So what should colleges and policy makers do? My findings suggest that a look at nonfinancial policies and programs, such as guidance counseling, transfer and articulation agreements with four-year colleges, and remediation, should be high on the agenda.

This article proceeds as follows. The next section provides evidence that better students do not sort into better community colleges, in contrast to students attending four-year colleges directly. This is the key feature of two-year sectors that permits the identification of the effect of institutional characteristics on schooling attainment. A simple model of sector and college choice is discussed to rationalize these patterns. Section 3 introduces the data, including my measure of college quality, and describes the empirical approach. The main results are presented in section 4. Section 5 concludes.

2. INSTITUTIONAL QUALITY AND STUDENT SORTING

Students seeking to earn a bachelor's degree face a wide variety of colleges to choose from. Colleges range in size, scope of degree and majors offered, cost, selectively, location, amenities, and many other important characteristics. One important dimension along which colleges differ is the financial resources they direct toward teaching their students. Figure 1 contains scatter plots of institutional performance (transfer rates and graduation rates) versus instructional expenditure per student, separately by sector. Four-year colleges are separated into private nonprofit and public colleges, and vocational-oriented two-year colleges are separated from other public two-year colleges.[5] There are substantial outcome and expenditure differences among these four groups and considerable variation within each group. The relationship between resources and outcomes also differs across these four sectors. Instructional expenditures are highly positively correlated with educational outcomes for four-year colleges (private more so than public) but seem to be uncorrelated (or negatively correlated) with transfer rates of two-year colleges.

In general, characteristics of individuals' colleges are not exogenous because better students attend higher-quality colleges due to selection by both students and colleges. As a result, these aggregate correlations may not reflect causation since they suffer from omitted variable bias: the effect of college quality on outcomes is combined with the effect of student ability. Previous authors have used a number of different strategies to deal with nonrandom assignment, including twins differencing (Behrman, Rosenzweig, and Taubman 1996), propensity score matching (Black and Smith 2004),

5. Vocational orientation is measured by the presence of the phrase "voc" or "tech" in the school's name.

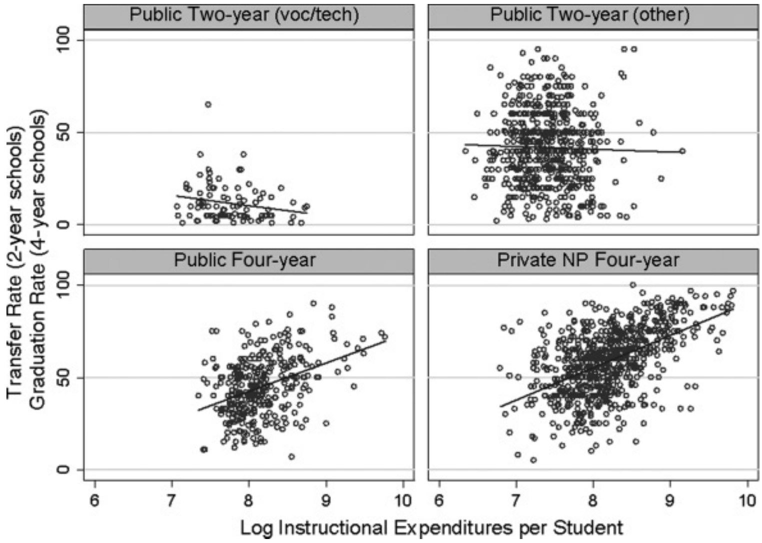

Figure 1. Aggregate Relationship between Institutional Performance and Instructional Expenditures, by School Type. *Notes:* Transfer rate is the fraction of all graduates of two-year programs that transfer to a four-year school. Graduation rate is the fraction of freshmen that graduate within five years. Both are self-reported by the colleges. Data are from author's tabulations from the College Board 1992 Annual Survey of Colleges (see http://professionals.collegeboard.com/higher-ed/recruitment/annual-survey) and the IPEDS 1992–93 Finance Survey (USDOE 1992).

conditioning on students' application/admissions set (Dale and Krueger 2002), instrumental variables (Long 2008), regression discontinuity (Hoekstra 2009; Saavedra 2008), and modeling the selection process itself (Brewer, Eide, and Ehrenberg 1999; Light and Strayer 2000). I circumvent this issue by recognizing that better students do not sort into better community colleges, in striking contrast to the four-year college sector. A simple model of college quality choice augmented with the discrete choice of whether to attend a local community college is developed in order to characterize the conditions that would give rise to these patterns. A key aspect is that community college quality is effectively assigned based on high school location rather than student aptitude, since most community college students simply attend the nearest one.[6]

6. This identification strategy is similar to other work that uses college proximity as an instrument to assess the returns to a college degree (Card 1995), the returns to college type (Kane and Rouse 1995), and the health consequences of maternal educational attainment (Currie and Moretti 2003). Long (2008) instruments for four-year college quality using the average quality of four-year colleges close to students' high school.

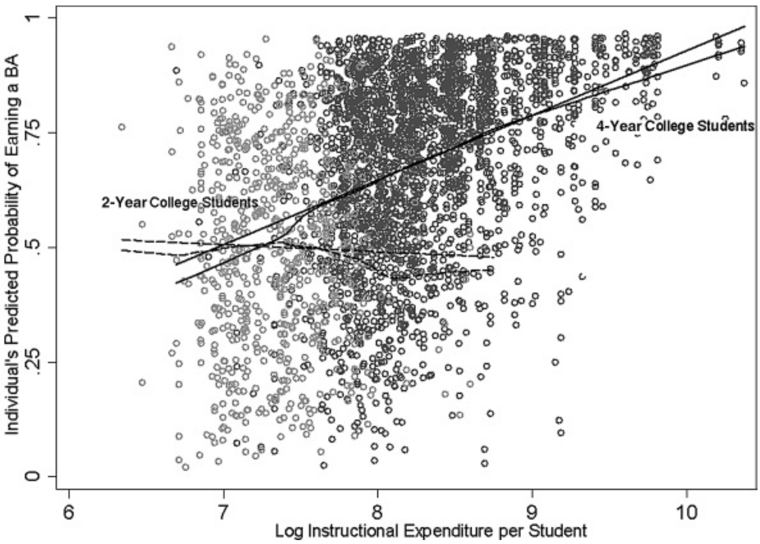

Figure 2. Average Student Aptitude, by College Quality. *Notes:* Predicted probability of earning a BA is estimated from a probit model with high school GPA, test scores, and indicators for race, female, parent BA, high family income, and region. All students are used in this estimation, regardless of type of college attended. Fitted values are from local least squares smoothing and linear regression, separately for students attending two-year (dashed line) and four-year (solid line) colleges.

Evidence of Student Sorting

Figure 2 provides a visual depiction of the relationship between student aptitude and institutional quality in my data.[7] As a simple measure of student aptitude, I predict the probability of earning a bachelor's degree given baseline characteristics (e.g., high school grade point average (GPA), test scores, and demographics) using results from a probit model estimated on all students in my sample. Two aspects of this figure are noteworthy. First, there is little overlap between two- and four-year colleges along this dimension of college quality. Generally speaking, institutional resources per student do a good job separating two-year from four-year colleges. Second, the presence of ability-based sorting is very apparent among four-year college students but absent for two-year college students.[8] There are virtually no students with unfavorable background characteristics attending high-resource four-year schools. This is

7. The data are discussed in more detail in the next section. Briefly, all the analyses use a matched student-institution data set constructed from the National Education Longitudinal Study and the Integrated Postsecondary Education Data System, which follows a cohort of students who graduated high school in 1992. The sample is restricted to high school graduates attending college and expecting to earn a four-year degree.
8. Appendix figure A.1 examines the correlation between student characteristics and college quality using multiple measures of each. The same general pattern (strong positive relationship for four-year college students, weak or no relationship for community college students) is mirrored for these individual measures.

not surprising: the same characteristics that determine the range of colleges admitted to (e.g., high school grades and test scores) are the same factors that predict collegiate success. In contrast, community colleges are typically open-enrollment institutions that do not specifically admit students based on aptitude. Rather, any student with a high school diploma (and sometimes even those without) residing in the same state is eligible to enroll in a local community college.

Table 1 presents more evidence on the relationship between school quality and baseline student characteristics for four- and two-year students who expect to earn a bachelor's degree. Students who attend four-year colleges with greater expenditure per student have baseline characteristics that are strongly correlated with the propensity to earn a bachelor's degree. The differences in high school and first-year college GPA, test scores, and race by college quality are large and significant. Unlike four-year students, however, differences in baseline characteristics between students who attend high- and low-expenditure community colleges are unsystematic and often not significant. For instance, two-year college resources are negatively correlated with parents' education and income but positively correlated with white racial classification. Grades and test scores are nearly identical at high- and low-quality schools. Overall, the probability of earning a BA, as predicted from a probit regression on baseline characteristics, is uncorrelated with community college quality. Table 1 also previews the article's main results—there are no significant differences in educational attainment between students attending high- and low-resource community colleges.

The lack of ability-based sorting among community college students arises from the fact that most attend the school closest to where they went to high school. Figure 3 examines distance traveled to college attended, by student aptitude. The left two panels plot the fraction of two- and four-year students that attend the public college nearest their high school, by student aptitude and college quality. Approximately 12 percent of four-year students attend the closest large, public four-year college, but this fraction declines considerably with student ability. High-achieving students are much less likely to attend the nearest public four-year college. Approximately 70 percent of students in my sample attend the nearest community college, and this fraction is uncorrelated with both student aptitude (top) and institutional resources (bottom). The average distance traveled to college is also strongly correlated with student aptitude and college quality for four-year college students but not for community college students. This is shown in the right-hand panels of Figure 3. Better students travel farther to attend better four-year colleges, but this effect is not present for community college students. In results not reported here, it does not appear that students attending community colleges other than the closest

Table 1. Differences in Outcomes and Baseline Student Characteristics by School Quality

	Four-Year College Students Expenditure per Student				Two-Year College Students Expenditure per Student			
	Low	**High**	**Difference**	***t*-stat**	**Low**	**High**	**Difference**	***t*-stat**
Total years of postsecondary schooling	4.47 (1.73)	5.14 (1.66)	0.67 (0.05)	12.64	3.40 (1.99)	3.37 (2.00)	−0.03 (0.12)	−0.25
Transferred to 4-year school					0.51 (0.50)	0.51 (0.50)	0.00 (0.03)	−0.09
Earned BA degree	0.67 (0.47)	0.84 (0.37)	0.17 (0.01)	12.87	0.33 (0.47)	0.32 (0.47)	−0.01 (0.03)	−0.25
Predicted probability of BA	0.63 (0.21)	0.76 (0.17)	0.12 (0.01)	16.40	0.51 (0.23)	0.50 (0.22)	−0.01 (0.02)	−0.48
HS GPA	3.05 (0.57)	3.31 (0.52)	0.26 (0.02)	13.04	2.71 (0.60)	2.72 (0.57)	0.02 (0.04)	0.37
College GPA (1st year)	2.61 (0.77)	2.80 (0.70)	0.20 (0.02)	8.48	2.50 (0.80)	2.49 (0.78)	−0.01 (0.05)	−0.15
Standardized test	0.66 (0.23)	0.80 (0.19)	0.14 (0.01)	20.94	0.53 (0.24)	0.52 (0.24)	−0.01 (0.02)	−0.55
Parent BA	0.39 (0.49)	0.65 (0.48)	0.25 (0.02)	16.40	0.31 (0.46)	0.26 (0.44)	−0.05 (0.03)	−1.77
Family income high	0.64 (0.48)	0.78 (0.41)	0.14 (0.02)	9.44	0.61 (0.49)	0.55 (0.50)	−0.06 (0.03)	−1.96
Black	0.09 (0.28)	0.07 (0.25)	−0.02 (0.01)	−2.53	0.06 (0.24)	0.08 (0.27)	0.02 (0.02)	1.26
Asian	0.06 (0.24)	0.15 (0.36)	0.09 (0.01)	9.04	0.10 (0.30)	0.05 (0.21)	−0.05 (0.02)	−3.48
Latino	0.09 (0.28)	0.06 (0.24)	−0.03 (0.01)	−3.39	0.18 (0.38)	0.12 (0.32)	−0.06 (0.02)	−2.67
White	0.76 (0.43)	0.72 (0.45)	−0.04 (0.01)	−2.83	0.66 (0.47)	0.75 (0.44)	0.09 (0.03)	3.22
Instructional expenditure per student ($1,000)	2.87 (0.57)	7.22 (4.36)	4.36 (0.10)	44.96	1.19 (0.18)	2.07 (0.60)	0.88 (0.03)	33.33

Notes: Number of observations is 4,127 four-year college students and 1,113 two-year college students, all of whom expected to earn a BA when asked during high school, though some variables have fewer observations due to missing values. High and low groups are defined as attending a college with instructional expenditure per student greater or less than the sample median. Predicted probability of BA is the fitted probability from a probit regression of earning a BA on high school GPA, test score, and indicators for parent BA, family income, race, gender, and region. This model is estimated on all students, regardless of the college attended.

one travel farther in search of higher-quality colleges, nor do higher-ability students travel farther, in contrast to four-year college students. Conditional on attending a school other than the closest one, there does not appear to be a relationship between student characteristics, school characteristics, and distance traveled among community college students.

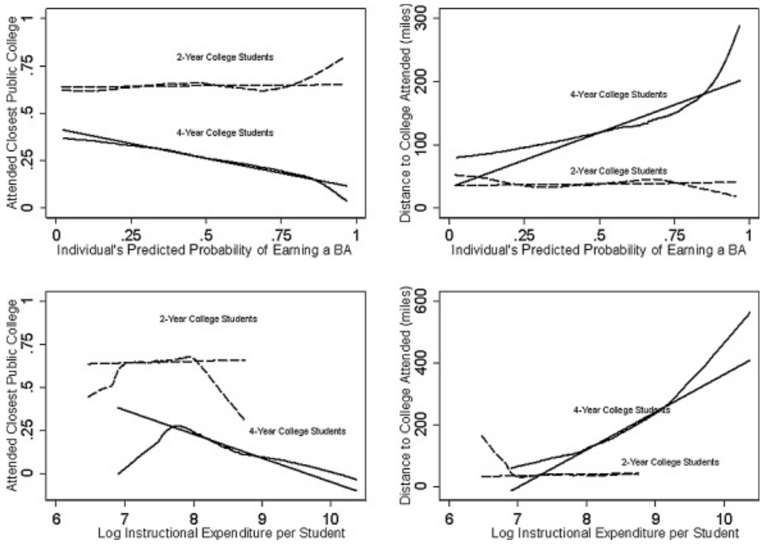

Figure 3. Average Distance Traveled to College Attended, by Student Aptitude and College Quality. *Notes:* Predicted probability of earning a BA is estimated from a probit model with high school GPA, test scores, and indicators for race, female, parent BA, high family income, and region. Fitted values are from local least squares smoothing and linear regression.

Why Don't Community College Students Sort?

This section summarizes the intuition from a theoretical model of college sector and quality choice that rationalizes these patterns. A mathematical treatment of the model, including simulations of the potential biases, is contained in a separate online appendix, which can be found on the *Education Finance and Policy* Web site (www.mitpressjournals.org/efp).[9]

Suppose students have preferences over schooling attainment and the cost of college quality, where attainment depends on college quality. Also suppose all individuals have the option to attend their local community college, which has a given quality level and whose cost is normalized to zero. Attending the nearest community college offers the opportunity to live at home, pay extremely low tuition fees, and minimize application effort, since most community colleges have open enrollment policies. However, attending a school other than the local community college incurs both a fixed cost (e.g., not living at home) and marginal (varying with college quality) cost. The fixed cost creates a discontinuity in the cost of college quality.

Students choose college quality to maximize utility subject to their individual-specific cost function. The cost discontinuity causes anyone whose

9. The model somewhat follows that of Card and Krueger (1996) but examines a setting of endogenous school quality and with a first-stage sector choice (four-year or two-year college).

incremental costs are sufficiently high to attend their local community college and all others to attend a college whose quality level equates the marginal benefit and cost. Among individuals not choosing the local community college, those with lower incremental costs will attend colleges of higher quality. Thus variation in college quality in the population arises from both variation in individual cost parameters and variation in the quality of local community colleges.

Selection bias arises if students' ability is correlated with either their fixed or marginal cost to college quality. Given the existence of merit-based scholarships and selective admissions, it is natural to assume that incremental cost would be negatively correlated with student aptitude. For example, high-ability students will require much less additional effort and money to gain admission to and attend elite colleges than mediocre students. In this case the ordinary least squares (OLS) estimate of the effect of quality on attainment will be positively biased. Conditional on attending a school other than the local community college, the relationship between quality and outcomes combines the true causal effect of college quality with the sorting of higher-ability students into higher-quality schools.

For students attending the local community college, selection still induces a positive bias in OLS estimates, but the nature of the selection is different. Variation in realized college quality is driven by both variation in the quality of the nearest community college and students' selection into community colleges from schools with other quality levels. Community colleges are more likely to attract high-ability students (low incremental cost) away from other schools if they are high-quality institutions themselves. Low-quality community colleges only attract students who would have chosen a low-quality non-community college, which are students that have lower academic ability.

This model implies that ability-based sorting should be particularly strong for students who do not attend the local community college. For these students, selection will confound estimates of the causal effect of college quality on schooling attainment regardless of the size of the true treatment effect. However, if the treatment effect of community college quality is zero, OLS will be unbiased regardless of the importance of fixed costs or their correlation with unobserved ability. In addition, if the fixed cost of attending a school beyond the local community college is uncorrelated with ability, increases in its variance will also minimize the bias in OLS estimates. In this case, the decision to attend the nearest community college is driven by factors other than community college quality, and the resulting bias is small. Neither of these changes reduces the OLS bias in the four-year sector.

All these results depend on the assumption that the quality of the local community college is uncorrelated with academic ability and the marginal and fixed costs of obtaining college quality beyond this local level. While not directly testable, I have presented graphical evidence that strongly suggests that college quality is uncorrelated with most community college student characteristics. A more complete model would also include both the decision to attend any college and the sector/quality choice modeled here. High-quality community colleges may draw more students in from non-enrollment, inducing a negative selection bias if students on the enrollment margin are lower ability. Since this negative bias would be countered by the positive bias on the two-year versus four-year margin, the net direction would be ambiguous. I examine this form of sorting explicitly and also restrict the primary analysis to students expecting to obtain a BA degree in order to partially eliminate this negative bias.

3. DATA AND EMPIRICAL APPROACH

Data

This article combines information from several sources to create a detailed data set of the characteristics of most U.S. postsecondary institutions that offer at least an associate's or bachelor's degree. The schools in this data set are then matched to longitudinal transcript and survey information on a recent cohort of U.S. high school graduates. Data on sector, enrollment, expenditure per student, faculty salary, and tuition of each college comes from the Integrated Postsecondary Education Data System (IPEDS) Institutional Characteristics; Fall Enrollment; Finance; and Salaries, Tenure, and Fringe Benefits surveys from 1992. Additional information on graduation and transfer rates and characteristics of the student body and faculty comes from the College Board's 1992 Annual Survey of Colleges (ASC). Latitude and longitude were assigned to each college based on zip code centroid (or in some cases city and state). There are approximately 1,000 public two-year, 500 public four-year, and 1,400 private nonprofit four-year colleges in the data set, which I then match to student-level data.

Student-level information on background and educational attainment is from the 1988 National Educational Longitudinal Survey (NELS) and Postsecondary Education Transcript Study (PETS). NELS/PETS provides a nationally representative sample of the U.S. high school class of 1992. Important for this article, the NELS provides long-term schooling outcomes for a large sample of high school graduates, which is unavailable for more recent cohorts.[10] All my

10. A long follow-up is particularly important for studying schooling outcomes in this context since community college transfer students typically take longer to graduate. A sufficient sample of community college students with long enough follow-up is not yet available for more recent cohorts from the Education Longitudinal Study of 2002 (ELS02; high school class of 2004) or the National Longitudinal Survey of Youth of 1997 (NLSY97; approximate high school classes of 1999–2003). Future analysis should examine these cohorts when the data become available.

data come from the restricted-use version of the 1992 and 2000 surveys and the corresponding postsecondary transcripts collected after the 2000 survey. From the transcripts I constructed measures of credits taken and indicators for enrollment at two-year or four-year institutions in each semester after high school. Student high school identifiers were used to match students to the address of their high school (in the Common Core of Data), which was then used to assign a latitude and longitude to each student. Using these coordinates, students were matched to the nearest two- and four-year colleges (and their characteristics) in their state.

This article is focused on BA degree attainment, so the data set was restricted to those students who graduated from high school in 1992, enrolled in college within one year of graduating, and expected to earn a bachelor's degree when asked during high school. I also exclude those for whom complete college transcript information was unavailable.[11] My main analysis focuses on the 1,113 remaining individuals who entered community college, though I also use the 4,127 four-year college entrants (restricted in a similar manner) in descriptive analysis.

The main outcomes are earning a bachelor's degree, transferring to a four-year college any time after the first year, and total years of postsecondary schooling (both graduate and undergraduate, constructed from total credit hours attempted divided by 30). All three are as of January 2000. I do not examine earnings or wages as outcomes because students in my sample have limited labor market experience at the time of the latest survey, so earnings at that time are a poor indicator of lifetime earnings. Appendix table A.1 provides summary statistics of the matched student-institution data set used in the analysis. Community college students in my data set attended college for an average of 3.4 years, 51 percent transferred, and 33 percent eventually earned a bachelor's degree.

Empirical Approach

I estimate the simple reduced form model of schooling attainment given in equation 1:

$$S_i = \gamma Q_j + \beta X_i + \varepsilon_i, \tag{1}$$

where S_i is the schooling outcome of individual i attending a college with quality Q_j, X_i is a vector of covariates, and ε_i is an error term assumed to

11. From the original data set of 12,144 individuals, 2,258 enrolled at a two-year school within the first year after normal high school graduation (spring 1992), according to the transcripts. Of these, 138 were not 1992 high school graduates, 825 did not expect a BA, 38 had incomplete transcript information, and 2 had missing high school location or lived in DC. Of the remaining 1,263, 150 were missing school expenditure data, leaving a final sample of 1,113 observations.

be uncorrelated with Q_j and X_i. The outcome variable S_i represents students' propensity for postsecondary schooling and will be interpreted as a latent index determining binary outcomes (i.e., earning a bachelor's degree or transferring to a four-year institution) and also measured directly by years of postsecondary schooling. I assume that college quality is one-dimensional. The vector of covariates contains individual, family, and regional variables, all of which should influence the costs or benefits of schooling. The parameter of interest is γ, which corresponds to the increased propensity for schooling associated with a unit increase in college quality, holding other determinants of attainment fixed.

Absent measurement error, OLS would provide an unbiased estimate of γ if college quality is independent of unobserved determinants of student attainment: $E[\varepsilon_i | Q_j, X_i] = 0$. While this assumption is not directly testable, the evidence in the previous section suggests that quality is independent of *observed* determinants of schooling attainment, or $E[X_i | Q_j] = 0$. This stems from the fact that students sort into their community colleges based on location rather than the attributes of colleges or themselves and that community college quality appears to be unrelated to locational attributes. For instance, if better community colleges were located near better high schools, we would expect a positive correlation between student ability and measured college quality. Alternatively, if students from better high schools require fewer resources to teach, we would expect to see a negative correlation between student ability and school resources. Neither pattern is observed in the data. Though possible, it seems unlikely that there would be sorting based on unobservables in the absence of sorting based on observables. I maintain this key identifying assumption, $E[\varepsilon_i | Q_j, X_i] = 0$, throughout the analysis. Some specifications include state fixed effects and economic characteristics of local areas to make this assumption more plausible.

Measuring College Quality

Most previous work uses average SAT score or admissions difficulty to measure college quality, but neither is applicable in the two-year college context because test scores are not required for admission, and most community colleges are open enrollment institutions. Instead I use financial resources—instructional expenditure per student—as my primary measure of college quality.[12] Figure 4 plots the distribution of log per student instructional expenditure among students in my sample. Spending at two-year colleges is lower on average and

12. Results are very similar if instead I use instructional expenditure per full-time equivalent (FTE) student (counting part-time students at 0.50 FTE).

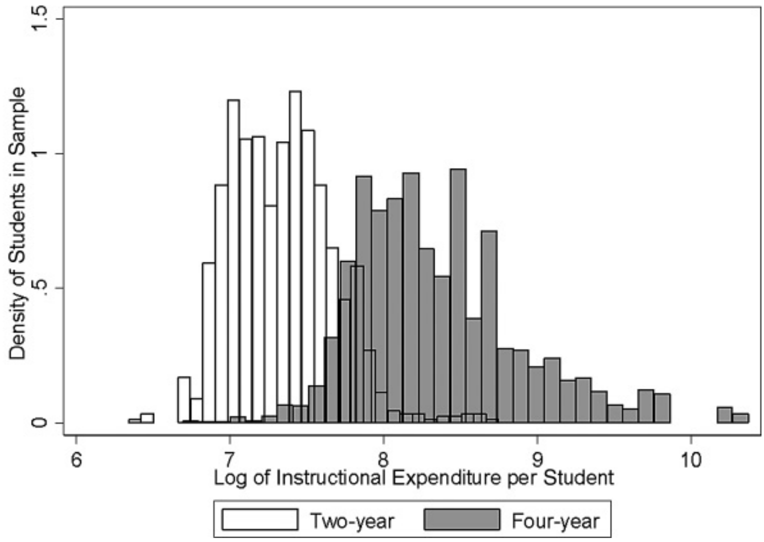

Figure 4. Distribution of Log Instructional Expenditure per Student, by Sector. *Notes:* Histograms plot the density of students in the sample, so institutions attended by more than one student will be counted multiple times. Interquartile range for two-year colleges is 1.18 to 1.90 (median = 1.54). Interquartile range for four-year colleges is 2.88 to 5.75 (median = 3.84).

more tightly distributed than that at four-year colleges, but there is still considerable variation among two-year colleges.

While other quality measures may be more appropriate for the other functions of community colleges (e.g., job placement rate for vocational programs), the present focus on BA-seeking students requires a measure that would be appropriate to four-year colleges as well. Expenditure per student is easily measured and comparable across institutions, but it does have some drawbacks. Spending is partially determined locally, so preferences for education may be correlated with spending, likely inducing a positive bias in estimates of spending on attainment. In addition, states may allocate greater resources to more expensive vocational programs, which may induce a negative correlation between spending and BA degree attainment if expensive two-year programs are more likely to be terminal. According to the Education Commission of the States (2000), approximately half of states rely on some amount of local financing for community colleges, though more than eight-tenths of all community college funding comes from nonlocal sources such as state appropriations, tuition/fees, and federal sources. Sixteen states also use program costs in some way to determine state allocations.

To address these shortcomings, I also use other measures of institutional resources (faculty salary and fraction of faculty that are full-time) and measures of peer orientation toward degree completion (fraction of students that are full

Table 2. Correlations between Instructional Expenditure and Other Measures of College Quality

	Pairwise Correlation Coefficients					
	Log Instruct. Expend. per Student	**Index of Four Other Measures**	**Adjusted Mean Faculty Salary**	**% Faculty Full Time**	**% Students Full Time**	**Mean Student Age**
Two-year colleges						
Log instruct. expend. per student	1.000					
Index of four other measures	0.496	1.000				
Adjusted mean faculty salary	0.148	0.363	1.000			
% faculty full time	0.438	0.805	0.224	1.000		
% students full time	0.483	0.793	0.223	0.461	1.000	
Mean student age	−0.305	−0.775	*−0.113*	−0.479	−0.472	1.000
Mean faculty salary	−0.202	*−0.115*	0.209	−0.170	−0.229	*0.036*
Four-year colleges						
Log instruct. expend. per student	1.000					
Index of four other measures	0.552	1.000				
Adjusted mean faculty salary	0.391	0.416	1.000			
% faculty full time	0.256	0.652	0.294	1.000		
% students full time	0.509	0.854	0.237	0.385	1.000	
Mean student age	−0.385	−0.765	−0.090	−0.264	−0.579	1.000
Mean faculty salary	0.654	0.330	0.591	0.188	0.219	−0.207
Freshman rejection rate	0.452	0.125	0.098	0.072	0.163	−0.155
SAT 75th percentile	0.730	0.535	0.350	0.227	0.478	−0.390
% freshman 3.0 HS GPA	0.503	0.400	0.255	0.136	0.318	−0.276

Notes: Correlations are estimated pairwise at the institution level, so the number of observations varies across the entries of the matrix due to missing values. There are 365 two-year and 984 four-year institutions attended by students in my sample with expenditure information. Quality index combines adjusted mean salary, percent faculty and students full time, and inverse of average student age using factor analysis. Correlations in italics are insignificant at the 95% level. All other correlations are significant at the 95% level or above.

time and average student age), as well as indexes constructed from multiple characteristics, as alternative measures of college quality.[13] Table 2 presents pairwise correlation coefficients between log instructional expenditure per

13. It should be noted that average student age and fraction of students full time used throughout this analysis are for the institutions overall as reported in surveys, not constructed from students in my sample.

student and these other quality measures for colleges attended by students in my sample, separately for two- and four-year schools. I divide average faculty salary for each institution by the median household income in the school's three-digit zip code from the 1990 census to account for geographic income differences. If community colleges draw faculty from local labor markets, average salaries should be normalized by area income.[14]

The final three rows report correlations between my measures of quality and three commonly used measures of four-year college quality not available for community colleges.[15] The rejection rate of freshman applicants, the 75th percentile of SAT scores among incoming freshmen, and the fraction of freshmen with at least a 3.0 high school GPA are all strongly correlated with instructional resources per student. Black and Smith (2006) conclude that SAT scores are the least noisy proxy for college quality, so it is encouraging that SAT scores have the highest correlation with my measures of college quality.[16]

4. DOES QUALITY INFLUENCE STUDENTS' EDUCATIONAL ATTAINMENT?

Figure 5 provides a graphical preview of my main result. For community college students, degree attainment has minimal correlation with instructional expenditures—students attending community colleges with relatively low and high levels of per student spending have comparable rates of degree attainment. In contrast, there is a very strong relationship between resources and student success for four-year college students. However, the model and evidence in section 2 suggest that this is in part due to better students attending better four-year colleges and is not necessarily causal.

Bachelor's Degree Attainment

Table 3 presents my main results. In the unadjusted relationship (column 1), I find no evidence that students who attend better community colleges are ultimately more likely to earn a bachelor's degree themselves. The point estimate is negative and very close to zero. It should be noted that a one-unit change

14. Nominal (rather than area income adjusted) salaries seem to be a more appropriate measure of quality for four-year colleges, reflecting the national nature of the labor market for four-year college professors. In my sample, the colleges with the highest average salaries are Harvard, MIT, Princeton, Stanford, and University of Chicago, which top the rankings using most measures of college quality.
15. I do not use the widely cited college rankings from *U.S. News and World Report* because these rankings are constructed separately for large national universities, smaller liberal arts colleges, and regional colleges, all of which appear in my data set.
16. Avery et al. (2004) introduce a completely different approach for ranking colleges using students' matriculation decisions as preference revealing. Schools that are able to attract admitted students from other schools receive higher ranks. With enough data, this approach could be extended to the two-year context by identifying which community colleges successfully attract students who could have attended four-year institutions instead.

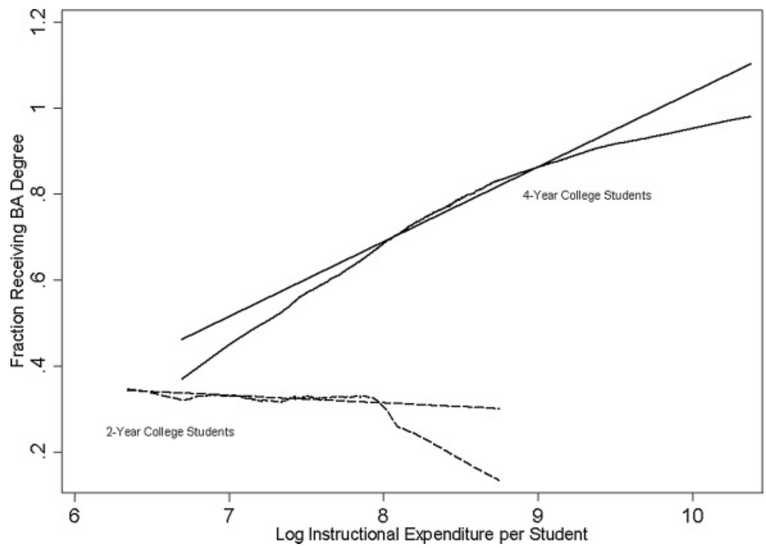

Figure 5. Fraction Earning BA Degree, by College Quality. *Note:* Fitted values are from local least squares smoothing and linear regression.

in log of instructional expenditure per student is very large, representing the difference between the 5th and 95th percentiles of my sample. Column 2 controls for individual and family covariates, including high school GPA, standardized test scores, demographics, and parental education and income. High school performance is a very strong predictor of degree attainment, and the other variables have the expected signs. Column 3 includes regional dummies and average state tuition at public two- and four-year colleges, to account for any regional differences in college quality that may be correlated with degree attainment. Consistent with the assumption that college quality is independent of observables, the estimated coefficient on college quality changes little when these covariates are introduced.

One identification concern is that state and local variation in funding for community colleges may be correlated with other unobserved factors that may influence degree attainment, such as K–12 school resources or community educational aspirations. In column 4 I control for median household income and the fraction of adults with BA degrees in the three-digit zip code area where each college is located. These variables have little predictive power and do not affect my estimates. Columns 5 and 6 replace census division fixed effects with state fixed effects. These specifications use variation in institutional resources between colleges within states to identify the effect of school resources. It should be noted that within-state estimates may be more prone to omitted variable bias if the variation arises primarily from local variation in income (and thus funding for community college). When state fixed

Table 3. Estimates of Effect of Instructional Expenditures on Degree Attainment: Community College Students

	Probit Model Dependent Variable: Earn BA Degree					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log instruct. expend. per student	−0.018 (0.042)	−0.014 (0.044)	−0.011 (0.049)	−0.012 (0.051)	−0.002 (0.063)	−0.002 (0.065)
HS GPA		0.200 (0.032)***	0.211 (0.033)***	0.214 (0.033)***	0.228 (0.034)***	0.230 (0.034)***
Standardized test		0.197 (0.071)***	0.195 (0.071)***	0.186 (0.071)***	0.192 (0.074)***	0.184 (0.074)**
Parent BA		0.043 (0.035)	0.042 (0.035)	0.040 (0.035)	0.043 (0.036)	0.042 (0.036)
Family income high		0.084 (0.034)**	0.081 (0.034)**	0.082 (0.034)**	0.089 (0.035)**	0.090 (0.035)***
Asian		0.006 (0.054)	−0.010 (0.056)	−0.019 (0.055)	0.019 (0.060)	0.008 (0.060)
Latino		−0.095 (0.039)**	−0.091 (0.041)**	−0.089 (0.042)**	−0.083 (0.043)*	−0.08 (0.043)*
Black		−0.190 (0.048)***	−0.193 (0.048)***	−0.192 (0.048)***	−0.192 (0.049)***	−0.192 (0.049)***
Female		0.022 (0.029)	0.020 (0.030)	0.019 (0.030)	0.025 (0.030)	0.024 (0.030)
Log state tuition 2-year			0.014 (0.044)	0.010 (0.044)		
Log state tuition 4-year			−0.061 (0.102)	−0.042 (0.102)		
Median income in zip3 area ($1,000)				−0.003 (0.003)		−0.004 (0.003)
% adults have BA in zip3 area				0.437 (0.278)		0.481 (0.298)
Census division fixed effects	No	No	Yes	Yes	No	No
State fixed effects	No	No	No	No	Yes	Yes
Observations	1,113	1,113	1,113	1,113	1,104	1,104

Notes: Robust standard errors are in parentheses. Reported probit coefficients are marginal effects. To minimize sample loss due to missing values, in all specifications I recode missing high school GPA, test scores, parent BA, and family income variables to zero and include indicators for these missing variables. Specifications (5) and (6) have fewer observations due to lack of outcome differences within a few small states.
*significant at 10%; **significant at 5%; ***significant at 1%.

effects are included, the point estimate is very close to zero. The inclusion of measures of school concentration (not reported) also has little effect on the point estimate.

Table 4. Estimates of Effect of Instructional Expenditures on Degree Attainment: Interactions

	Linear Probability Model (OLS) Dependent Variable: Earn BA Degree				
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Log instruct. expend. per student	−0.012 (0.045)	0.011 (0.066)	0.015 (0.053)	0.001 (0.052)	−0.025 (0.049)
Log instruct. expend. per student X					
Female		−0.042 (0.081)			
Asian			0.008 (0.166)		
Latino			−0.260 (0.119)*		
Black			−0.020 (0.111)		
HS GPA 25–50th percentile				−0.009 (0.009)	
HS GPA 50–75th percentile				−0.005 (0.014)	
HS GPA > 75th percentile				−0.006 (0.019)	
Standardized test 25–50th percentile					0.004 (0.008)
Standardized test 50–75th percentile					0.013 (0.014)
Standardized test > 75th percentile					0.008 (0.020)
Observations	1,113	1,113	1,113	857	997

Notes: All models include a full set of background, state tuition, and census division controls and are analogous to specification (3) in table 3. Robust standard errors are in parentheses. To minimize sample loss due to missing values, in all specifications missing high school GPA, test scores, parent BA, and family income variables are recoded to zero, and indicators for these missing variables are included in the regression. Specifications (4) and (5) omit observations with missing high school GPA and test scores, respectively.
*significant at 5%.

In table 4, I test for effect heterogeneity by subgroup by including interactions between the main background characteristics and the log of instructional expenditures per student.[17] All models include a full set of background covariates, average state tuition, and census division fixed effects, analogous to

17. The interaction effects are estimated with a linear probability model (OLS) rather than a nonlinear probit model so that the interaction terms are immediately interpretable as marginal effects. See Ai and Norton (2003) for a discussion. The linear and nonlinear models generate almost identical marginal effect estimates for the noninteraction specifications.

specification 3 in table 3. While resources seem to be more beneficial to male and Asian students relative to female, white, black, and Latino students, only the Latino difference is statistically significant. Columns 4 and 5 test for differences by academic ability, as indicated by high school grade point average and standardized test scores. I find no evidence that greater resources increase BA degree completion rates for any academic ability subgroup. In results not reported here, I also find no difference in the estimated coefficient by whether a student attended the nearest community college.

As a point of comparison, appendix table A.2 repeats the main analysis, but on the sample of students who attended four-year colleges directly after high school. Consistent with the previous literature on college quality, I find that students attending four-year colleges with more resources are much more likely to complete a bachelor's degree. However, this correlation is driven in large part by the sorting of better students into better colleges: controlling for student characteristics reduces the coefficient by half. Given the presence of considerable selection on observables, selection on unobservables is likely, and these estimates for four-year college students should not be interpreted as causal.

My point estimates suggest that the elasticity of degree attainment with respect to institutional resources is low at two-year colleges. However, my estimates are imprecise, and I cannot rule out positive effects of 0.065 (no controls) to 0.124 (state fixed effects) points resulting from a one-unit increase in log expenditures, which corresponds to an elasticity of 0.20—0.38.

Other Educational Outcomes

Though I find no evidence that students attending community colleges with more instructional resources are more successful at earning a bachelor's degree, it is possible that effects are greater on other educational outcomes, since many students do not complete a bachelor's degree. Table 5 examines the effect on rates of transfer (columns 1–3) and total years of schooling (columns 4–6). I find no evidence that per student spending improves rates of transfer. The point estimates are very close to zero even after including state fixed effects. As with degree attainment, the estimate changes little when a rich set of covariates and regional or state fixed effects are included.

Columns 4–6 present OLS estimates of equation 1 using years of postsecondary schooling as the dependent variable. Again, the point estimates are quantitatively small, statistically insignificant, and unaffected by the inclusion of individual control variables. The model that includes state fixed effects generates larger (though statistically insignificant) estimates, though the elasticity is still quite low (about 0.03).

Table 5. Estimates of Effect of Instructional Expenditures on Other Educational Outcomes

	Probit: Transferred to Four-Year College			OLS: Years of Postsecondary Schooling		
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log instruct. expend. per student	−0.020 (0.045)	−0.004 (0.054)	0.000 (0.073)	−0.092 (0.179)	0.037 (0.209)	0.083 (0.256)
HS GPA		0.222 (0.036)***	0.234 (0.038)***		0.821 (0.121)***	0.873 (0.125)***
Standardized test		0.173 (0.077)**	0.155 (0.081)*		0.881 (0.292)***	0.744 (0.299)**
Parent BA		0.083 (0.038)**	0.099 (0.039)**		0.172 (0.134)	0.207 (0.134)
Family income high		0.107 (0.036)***	0.115 (0.037)***		0.423 (0.136)***	0.471 (0.136)***
Asian		−0.005 (0.064)	0.019 (0.069)		0.161 (0.228)	0.224 (0.238)
Latino		−0.026 (0.049)	−0.001 (0.051)		−0.09 (0.188)	−0.069 (0.193)
Black		−0.119 (0.066)*	−0.115 (0.068)*		−0.652 (0.230)***	−0.633 (0.232)***
Female		−0.053 (0.032)	−0.059 (0.033)*		−0.013 (0.117)	−0.034 (0.117)
Log state tuition 2-year		−0.012 (0.048)			−0.274 (0.163)*	
Log state tuition 4-year		0.030 (0.113)			0.178 (0.379)	
Median income in zip3 area ($1,000)		−0.002 (0.003)	−0.002 (0.003)		−0.013 (0.011)	−0.017 (0.012)
% adults have BA in zip3 area		0.635 (0.308)**	0.573 (0.335)*		1.84 (1.119)	1.893 (1.216)
Census division fixed effects	No	Yes	No	No	Yes	No
State fixed effects	No	No	Yes	No	No	Yes
Observations	1,113	1,113	1,106	1,113	1,113	1,113

Notes: Robust standard errors are in parentheses. Reported probit coefficients are marginal effects. To minimize sample loss due to missing values, in all specifications missing high school GPA, test scores, parent BA, and family income variables are recoded to zero and include indicators for these missing variables. Specification (3) has fewer observations due to lack of outcome differences within a few small states.
*significant at 10%; **significant at 5%; ***significant at 1%.

Alternative Measures of Quality

Table 6 assesses the robustness of the main results to how college quality is measured. Each cell represents a separate regression, with rows corresponding to different quality measures and columns corresponding to different

Table 6. Estimated Effects Using Multiple Measures of College Quality

	Probit: Earn BA Degree	Probit: Transferred to 4-year College	OLS: Total Years Enrolled in College
	(1)	(2)	(3)
Individual measures (standardized):			
Log instruct. expend. per student	0.019 (0.032)	−0.005 (0.035)	0.117 (0.122)
Adjusted mean faculty salary	−0.037 (0.021)*	−0.032 (0.024)	−0.045 (0.079)
% faculty full time	0.019 (0.021)	−0.001 (0.024)	0.141 (0.082)*
% students full time	−0.028 (0.021)	−0.034 (0.024)	0.032 (0.080)
Inverse of mean student age	−0.003 (0.022)	−0.007 (0.025)	0.058 (0.081)
Quality index combining:			
Adjusted faculty salary, % faculty FT, % students FT, and inverse of mean student age (factor analysis weights)	−0.011 (0.022)	−0.023 (0.025)	0.090 (0.084)
Adjusted faculty salary, % faculty FT, % students FT, and inverse of mean student age (equally weighted)	−0.023 (0.030)	−0.020 (0.033)	0.122 (0.113)
Adjusted faculty salary and % faculty FT	−0.013 (0.021)	−0.022 (0.024)	0.056 (0.078)
Adjusted faculty salary and % students FT	−0.042 (0.020)**	−0.042 (0.023)*	−0.009 (0.075)
Adjusted faculty salary and inverse of avg. student age	−0.027 (0.021)	−0.026 (0.024)	0.007 (0.077)
% faculty FT and % students FT	−0.008 (0.022)	−0.023 (0.025)	0.103 (0.084)
% faculty FT and inverse of mean student age	0.009 (0.022)	−0.005 (0.024)	0.117 (0.082)
% students FT and inverse of mean student age	−0.020 (0.023)	−0.026 (0.025)	0.054 (0.086)
Observations	738	738	738

Notes: Each cell represents a separate regression (see text). All regressions include all covariates and census division fixed effects and are analogous to specification (4) in table 4. Robust standard errors are in parentheses. Reported probit coefficients are marginal effects. All quality measures are standardized to have mean zero and standard deviation 1 in a sample of all community colleges. Sample includes only individuals with non-missing values for all five individual quality measures.
*significant at 10%; **significant at 5%.

outcomes. In addition to using several individual measures, I also follow the procedure of Black and Smith (2004, 2006) and Long (2008) and combine multiple quality measures into a single index of latent college quality using factor analysis. Black and Smith (2006) caution against using a single measure of college quality, given that it will be noisily measured and with unknown bias if not classical. The four measures included in the index are adjusted mean faculty salary, fraction of faculty that are full time, fraction of students that are full time, and (inverse of) average student age. Together these measures reflect faculty resources and the degree orientation of peer students, since older and part-time students are less likely to earn a bachelor's degree. More weight is given to variables that measure latent quality with less error, as indicated by having greater correlation with the other proxies, assuming the measures are independent.[18] I also construct an index that puts equal weight on all four measures and indexes that combine only pairs of measures.[19] To facilitate comparability, each individual and index measure of quality is normalized to mean zero and unit standard deviation in the population of two-year institutions for which data were available.

For BA degree attainment, the estimated effect is never positive and significant at conventional levels, though the point estimates vary somewhat across the different indexes, ranging from positive 1.9 percentage points to negative 4.2 percentage points for a one-unit change in quality. These estimates all fall within the 95 percent confidence interval of the preferred point estimate of 1.9 points, using (standardized) log instructional expenditure per student.

Column 2 examines the effect of college quality on the probability of transferring from community college to a four-year program. The estimates range from negative 4.2 to 0.1 percentage points across the various measures of college quality, though none is significantly different from zero at the 95 percent level. Column 3 examines total years of schooling. The estimates range from −0.04 to 0.14 additional years associated with a one-unit increase in college quality, which is quantitatively very small given that the average number of years of schooling is 3.4 years for my sample. Overall, there seems to be only a very modest effect, if any, of college quality on the educational attainment of community college students.

Nearby Institutional Quality and Sample Composition

One potential source of bias in the preceding analysis is the endogeneity of sample composition. The resources and quality of students' nearby community college may influence their degree aspirations, enrollment, and sector choice. If so, the composition of my sample will be correlated with institutional quality,

18. The weights given to each proxy variable in the index are from the factor loadings in the first principle component: adjusted mean faculty salary (0.090), faculty percent full time (0.342), students percent full time (0.326), inverse of mean age (0.313).
19. Black and Smith (2006) prefer a generalized method of moments (GMM) approach that addresses both the scaling and attenuation bias caused by measurement error, but in practice their GMM estimate is nearly identical to their estimate from the factor analysis approach taken here.

and the results may be biased. The net direction of the bias is ambiguous: students moving from non-enrollment will likely cause negative bias, whereas those along the four-year/two-year margin may cause positive bias. While a complete examination of the determinants of schooling aspirations and college choice is beyond the scope of this article, table 7 presents evidence on the relationship between nearby community college quality and inclusion in my sample.

Nearby community college resources have little noticeable relationship with students' probability of expecting to obtain a BA degree. Though individual characteristics (e.g., high school GPA) are strongly correlated with expectations in the expected direction, the characteristics of nearby four-year and two-year colleges are not. The pattern is very similar for students' overall enrollment decisions among those expecting a BA degree. Resources have a very weak relationship with enrollment. It appears that the scope for negative bias due to sample composition along the enrollment margin is minimal.

Column 3 of table 7 examines the choice of two-year or four-year colleges among those attending either type of college. Contrary to expectations, high-resource community colleges actually attract fewer students from four-year colleges than low-resource colleges. This negative correlation is robust to the inclusion of state fixed effects, school tuition and fees, and historical vocational/technical orientation, though these latter results are not reported here. All other variables have the anticipated sign: students are more likely to attend the nearest type of school, and higher-aptitude students are more likely to attend four-year schools. The direction of possible bias depends on the characteristics of students sorting away from two-year schools to four-year schools. Column 4 reveals that high-aptitude students (as measured by high school grades) living near high-resource two-year schools are relatively more likely to attend two-year schools themselves. Thus sorting between sectors may bias our estimates toward finding positive effects if observed aptitude is correlated with unobserved ability. It should be recalled, however, that sorting by observable characteristics among students within the two-year sector is nonexistent. Column 5 suggests that cross-sector sorting may be less severe along other dimensions of school quality.

5. CONCLUSION AND DISCUSSION

This article finds that attending a higher-quality community college (as measured by greater instructional expenditure per student) has no impact on students' educational attainment. This finding is robust to extensive individual controls, regional and state fixed effects, and alternative measures of quality. An extensive descriptive analysis of student sorting also reveals no evidence that better students attend higher-quality community colleges, in

Table 7. Nearby Institutional Quality, Degree Aspirations, and Schooling Choices

	Probit		Linear Probability Model (OLS)		
	(1)	(2)	(3)	(4)	(5)
Nearest 2-year: Log instruct. expend. per student	−0.011 (0.024)	−0.003 (0.020)	−0.101 (0.027)***	−0.381 (0.103)***	
Nearest 4-year: Log instruct. expend. per student	−0.004 (0.012)	0.001 (0.008)	−0.004 (0.012)	−0.007 (0.014)	
Nearest 2-year: Log instruct. expend. per student X HS GPA				0.106 (0.029)***	
Nearest 2-year: Quality index					−0.021 (0.021)
Nearest 4-year: Quality index					0.026 (0.016)*
Distance to nearest 2-year (100 miles)	−0.069 (0.044)	−0.037 (0.033)	−0.270 (0.047)***	−0.265 (0.050)***	−0.430 (0.108)***
Distance to nearest 4-year (100 miles)	−0.063 (0.026)**	0.019 (0.020)	0.122 (0.035)***	0.09 (0.036)**	0.011 (0.051)
HS GPA	0.131 (0.013)***	0.086 (0.010)***	−0.163 (0.016)***	−0.963 (0.217)***	−0.242 (0.024)***
Standardized test	0.535 (0.030)***	0.181 (0.024)***	−0.4 (0.037)***	−0.35 (0.044)***	−0.354 (0.061)***
Parent BA	0.161 (0.014)***	0.067 (0.011)***	−0.057 (0.016)***	−0.046 (0.018)**	−0.066 (0.026)**
Family income high	0.067 (0.015)***	0.045 (0.012)***	−0.027 (0.017)	−0.027 (0.020)	−0.006 (0.028)
Asian	0.125 (0.022)***	0.025 (0.018)	−0.144 (0.021)***	−0.147 (0.026)***	−0.127 (0.040)***
Latino	0.022 (0.023)	−0.005 (0.019)	−0.026 (0.030)	−0.044 (0.035)	−0.063 (0.045)
Black	0.192 (0.013)***	−0.001 (0.018)	−0.173 (0.027)***	−0.204 (0.029)***	−0.142 (0.042)***
Female	0.028 (0.013)**	0.016 (0.010)	0.03 (0.014)**	0.045 (0.016)***	0.025 (0.022)
Median income in zip3 area ($1,000)	0.003 (0.002)	0.000 (0.001)	0.002 (0.002)	0.002 (0.002)	0.004 (0.003)
% adults have BA in zip3 area	0.007 (0.154)	−0.010 (0.121)	−0.289 (0.166)*	−0.276 (0.195)	−0.628 (0.275)**
State fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	5,063	3,520	3,035	2,366	1,167

Notes: Robust standard errors are in parentheses. Reported probit coefficients are marginal effects. To minimize sample loss due to missing values, in all specifications missing high school GPA, test scores, parent BA, and family income variables are recoded to zero and include indicators for these missing variables. Specification (1) includes all 1992 high school graduates with complete transcript information (or no postsecondary schooling). Specification (2) further restricts the sample to individuals expecting a BA. Specifications (3)–(5) further restrict analysis to students who attended a two- or four-year college within a year of high school graduation. Specification (5) has fewer observations due to missing measures used to construct the quality index.
*significant at 10%; **significant at 5%; ***significant at 1%.

contrast to the four-year sector. The lack of ability-based sorting seen in the data allows institutional quality to be treated as if it were randomly assigned conditional on community college attendance. This assumption is further supported by the fact that including a rich set of covariates does not affect the estimates.

The zero effect I find is in contrast to the generally positive school quality effects found at four-year colleges (Long 2008).[20] What underlies this difference between the four-year and two-year sectors? One possibility is that local community colleges face little competition for transfer students and thus have little incentive to use resources effectively for that purpose. While community colleges do compete against private for-profit schools for vocational and other sub-baccalaureate education (see Cellini 2009), this may not be the case for their BA transfer function. The diversity of postsecondary functions that community colleges perform (see Cohen and Brawer 2008) may thus hamper their ability to direct adequate resources specifically toward transfer students. In contrast, the market for a four-year education has increasingly become nationally integrated (Hoxby 1997) and appears to be competitive (Epple, Romano, and Sieg 2006). This should ensure that resources are used effectively in that market and that returns to college quality are positive. While this article does not speak directly to the importance of these market structure differences between the two sectors, it has uncovered striking differences in patterns of sorting and the returns to college quality between sectors. These sector differences are poorly understood and are not currently factored into many policy discussions. More research on the markets in which community colleges operate, the education production function at community colleges, and even what appropriate measures of quality are in the sector would all be welcome additions to this discussion.

In the current economic environment, colleges will have no choice but to help their students succeed with fewer resources, as forty-three states recently cut funding to public colleges and universities (Johnson, Oliff, and Williams 2010). Encouragingly, my findings suggest that nonfinancial practices, policies, and cultural factors may be more prominent in community college students' success than is spending. To take one example, many states have formalized transfer policies through the use of statewide articulation agreements between public universities and community colleges in order to facilitate transfers (Education Commission of the States 2001). While Anderson, Sun, and Alfonso (2006) find no effect of these agreements, surely more

20. This finding is consistent with work suggesting that greater resources alone do not improve student achievement in the K–12 context (Hanushek 2006).

research is needed on the specific policies that states and colleges are implementing to facilitate transfer. Mixed methods studies, like the quantitative and case study work by Jenkins (2007), may be particularly useful in uncovering what creates an institutional culture geared toward transfer success. Identifying these nonfinancial factors should be at the forefront of college leaders' and policy makers' agendas.

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APPENDIX

Table A.1. Summary Statistics of Matched Individual-Institution Data

	Four-Year College Students				Two-Year College Students			
	Mean	Std. Dev.	Min	Max	Mean	Std. Dev.	Min	Max
Schooling Outcomes								
Earned BA	0.75	0.43	0.00	1.00	0.33	0.47	0.00	1.00
Transferred					0.51	0.50	0.00	1.00
Total years in college	4.81	1.73	0.09	13.47	3.39	1.99	0.03	10.50
Characteristics of College Attended								
Instruct. expend. per student ($1,000)	5.05	3.80	0.81	31.99	1.63	0.62	0.57	6.29
Mean faculty salary ($10,000)	4.76	1.00	1.60	7.96	3.93	0.71	2.44	6.16
Adjusted mean faculty salary	1.72	0.40	0.39	2.94	1.30	0.27	0.65	2.21
% faculty full time	0.76	0.15	0.09	0.99	0.42	0.16	0.10	0.99
% students full time	0.87	0.11	0.28	1.00	0.39	0.17	0.00	1.00
Mean student age	21.73	2.09	18.00	33.00	27.18	2.61	19.00	37.00
Individual Characteristics								
HS GPA	3.17	0.56	0.30	4.00	2.71	0.59	0.14	4.00
Standardized test	0.73	0.22	0.01	1.00	0.52	0.24	0.01	0.99
Parent BA	0.52	0.50	0.00	1.00	0.28	0.45	0.00	1.00
Family income high	0.71	0.45	0.00	1.00	0.58	0.49	0.00	1.00
White	0.74	0.44	0.00	1.00	0.70	0.46	0.00	1.00
Asian	0.11	0.31	0.00	1.00	0.07	0.26	0.00	1.00
Latino	0.07	0.26	0.00	1.00	0.15	0.35	0.00	1.00
Black	0.08	0.26	0.00	1.00	0.07	0.26	0.00	1.00
Female	0.55	0.50	0.00	1.00	0.55	0.50	0.00	1.00
Regional Tuition								
Mean 2-year tuition in state	1,555	872	280	3,476	1,312	829	280	3,476
Mean 4-year tuition in state	2,362	767	1,192	4,265	2,185	669	1,192	4,265

Notes: Number of observations is 4,127 four-year college students and 1,113 two-year college students, all of whom expected to earn a BA when asked during high school and had non-missing college expenditure measures, though some variables have fewer observations due to missing values. College characteristics are obtained from the colleges themselves and reflect all students, not just those in my sample. Adjusted mean faculty salary is mean faculty salary divided by median income in the three-digit zip code to account for geographical income differences.

Table A.2. Estimates of Effect of Instructional Expenditures on Degree Attainment: Four-Year College Students

	Probit Model Dependent Variable: Earn BA Degree					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Log instruct. expend. per student	0.197 (0.014)***	0.105 (0.015)***	0.100 (0.016)***	0.104 (0.017)***	0.099 (0.016)***	0.105 (0.018)***
HS GPA		0.182 (0.017)***	0.189 (0.017)***	0.190 (0.017)***	0.198 (0.018)***	0.198 (0.018)***
Standardized test		0.112 (0.036)***	0.109 (0.036)***	0.104 (0.036)***	0.106 (0.037)***	0.103 (0.037)***
Parent BA		0.111 (0.015)***	0.112 (0.015)***	0.111 (0.015)***	0.104 (0.015)***	0.104 (0.015)***
Family income high		0.060 (0.017)***	0.058 (0.017)***	0.058 (0.017)***	0.062 (0.017)***	0.062 (0.017)***
Asian		0.027 (0.023)	0.031 (0.023)	0.029 (0.024)	0.016 (0.025)	0.016 (0.025)
Latino		−0.131 (0.031)***	−0.112 (0.031)***	−0.114 (0.031)***	−0.126 (0.034)***	−0.127 (0.034)***
Black		−0.045 (0.027)*	−0.049 (0.028)*	−0.052 (0.028)*	−0.05 (0.029)*	−0.05 (0.029)*
Female		0.048 (0.014)***	0.047 (0.014)***	0.047 (0.014)***	0.047 (0.014)***	0.047 (0.014)***
Log state tuition 2-year			−0.001 (0.024)	0.001 (0.024)		
Log state tuition 4-year			0.055 (0.043)	0.054 (0.043)		
Median income in zip3 area ($1,000)				0.003 (0.001)**		0.003 (0.001)**
% adults have BA in zip3 area				−0.048 (0.102)		−0.085 (0.103)
Census division fixed effects	No	No	Yes	Yes	No	No
State fixed effects	No	No	No	No	Yes	Yes
Observations	4,127	4,127	4,127	4,113	4,102	4,088

Notes: Robust standard errors are in parentheses. Reported probit coefficients are marginal effects. To minimize sample loss due to missing values, in all specifications missing high school GPA, test scores, parent BA, and family income variables are recoded to zero and include indicators for these missing variables. Specifications (5) and (6) have fewer observations due to lack of outcome differences within a few small states.
*significant at 10%; **significant at 5%; ***significant at 1%.

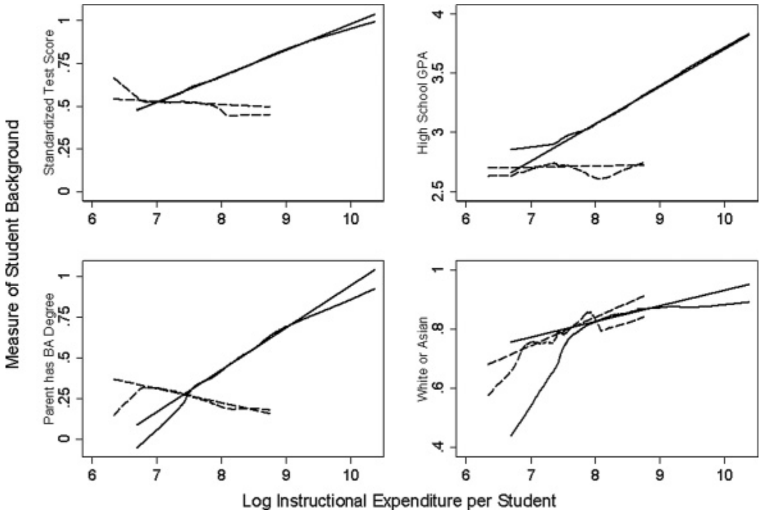

Figure A.1.

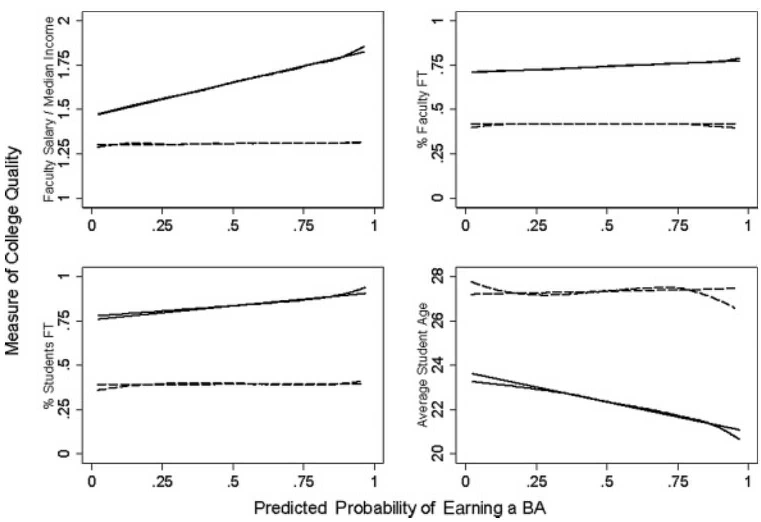

Figure A.2.

Figures A.1 and A.2. Relationship between Student and College Characteristics. *Notes:* Predicted probability of earning a BA is estimated from a probit model with high school GPA, test scores, and indicators for race, female, parent BA, high family income, and region. Fitted values are from local least squares smoothing and linear regression. Dashed lines = two-year colleges; solid lines = four-year colleges.