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The Community College Effect Revisited: The Importance of Attending to Heterogeneity and Complex Counterfactuals

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Abstract: Community colleges are controversial educational institutions, often said to simultaneously expand college opportunities and diminish baccalaureate attainment. We assess the seemingly contradictory functions of community colleges by attending to effect heterogeneity and alternative counterfactual conditions. Using data on postsecondary outcomes of high school graduates of Chicago Public Schools, we find that enrolling at a community college penalizes more advantaged students who otherwise would have attended four-year colleges, particularly highly selective schools; however, these students represent a relatively small portion of the community college population, and these estimates are almost certainly biased. On the other hand, enrolling at a community college has a modest positive effect on bachelor's degree completion for disadvantaged students who otherwise would not have attended college; these students represent the majority of community college-goers. We conclude that discussions among scholars, policymakers, and practitioners should move beyond considering the pros and cons of community college attendance for students in general to attending to the implications of community college attendance for targeted groups of students.

Keywords: community college; bachelor's degree; heterogeneity; Chicago Public Schools

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Community colleges are among the most controversial educational institutions (Goldrick-Rab 2010). They are alternatively depicted as creating accessible, affordable, and expanded opportunities for postsecondary education (e.g., Cohen and Brawer 1982; Shaw, Goldrick-Rab, Mazzeo, and Jacobs 2006; Shavit, Arum, and Gamoran 2007), or as steering less advantaged youth away from selective colleges and universities (e.g., Brint and Karabel 1989; Clark 1960; Karabel 1972). This combination of apparently countervailing functions led Dougherty (1994) to describe the public two-year institution as a "contradictory college." Policymakers are increasingly concerned about the outcomes associated with attending community college as enrollment in the sector continues to grow, and as more than 80 percent of entering students say they want to earn a bachelor's degree, but only about 12 percent complete that degree within six years (Century Foundation 2013). These figures, coupled with high levels of socioeconomic segregation within higher education, suggest that community college attendance may play an important role in the degree to which American higher education perpetuates, or even exacerbates, social inequality.

At the center of the debate is the so-called "community college effect," an average estimate that is interpreted as increasing or decreasing inequality in educational outcomes depending upon whether it is negative or positive, respectively. To the extent that community colleges promote social mobility, individuals who do not attend them are left further behind. But if community colleges instead diminish opportunities for bachelor's degree completion by drawing students away from baccalaureate-granting colleges, gaps in educational attainment may be exacerbated. Over the last several decades, dozens of empirical studies have estimated both positive democratizing effects of community college as well as negative diversionary effects (e.g., Alba and Lavin 1981; Alfonso 2006; Brint and Karabel 1989; Clark 1960; Doyle 2009; Dougherty

1994; Grubb 1991; Leigh and Gill 2003; Long and Kurlaender 2009; Melguizo, Kienzl, and Alfonso 2011; Reynolds 2012; Reynolds and DesJardins 2009; Rouse 1995; Sandy, Gonzalez, and Hilmer 2006; Whitaker and Pascarella 1994). Yet current public conversations about community college often focus exclusively on the negative effects, with policymakers and practitioners warning about the penalty accruing to students seeking bachelor's degrees who enter public two-year schools. In fact, in Chicago Public Schools, the site of this study, some schools have began to actively discourage students from attending community college, urging them to find a better college match (Roderick et al. 2011; Bowen et al. 2009).

In this paper, we argue that an accurate characterization of community colleges depends upon a clearer understanding of the extent to which the effects are heterogeneous—simultaneously advantaging some students while disadvantaging others. Given the vast and growing compositional heterogeneity among undergraduate students, it is unlikely that attending community college affects all students in the same way. By systematically attending to the probable alternative paths community college students would have otherwise followed, and to community college effect heterogeneity, we can better interpret the outcomes associated with community college attendance. This increases the accuracy with which we describe mechanisms of social stratification and affects the positioning of community colleges within the educational policy landscape, where they are increasingly critiqued for what appear to be poor outcomes (Goldrick-Rab 2010).

We assess multiple treatment effects of community college attendance on bachelor's degree completion using rich longitudinal survey and administrative data on the postsecondary trajectories of students graduating from Chicago Public Schools. Although community colleges serve multiple functions, including technical training, remediation, and enrichment, implicating many potential outcomes of interest, arguably a central function is providing an affordable and accessible route to a four-year degree. Thus, examining effects on bachelor's degrees has been the focus of most debate and study. We test the hypothesis that the average democratizing and diversionary effects of community college attendance are in fact different effects for different students. We consider a range of counterfactuals for individuals who do not attend community colleges and empirically demonstrate how the relevant alternatives to community college attendance apply to subpopulations of students with different propensities to attend.

We find a modest positive (democratizing) effect of community college attendance relative to students who do not attend postsecondary schooling within one year of high school completion. These students generally have a high propensity to attend community college and represent the majority of the community college population. Our results indicate that the purported penalty to attending community college may be overstated, since it accrues only to a small subpopulation of students who would have otherwise attended selective, and especially highly selective, four-year colleges. We conclude that discussions among education and stratification scholars should move beyond considering the pros and cons of community college attendance for students in general to attending to the implications of community college attendance for specific groups of students with differing propensities to attend.

Background and Significance

The community college is a key contributor to the diversity of American higher education (Shavit, Arum, and Gamoran 2007). Public two-year colleges absorbed much of the expansion in postsecondary enrollment that occurred in the mid-twentieth century, such that more than forty percent of all undergraduate students in the United States currently attend community college (American Association of Community Colleges 2011). Community colleges are tasked with maintaining easy access to a college education and providing a gateway to educational attainment and other socioeconomic opportunities (Cohen and Brawer 1982; Goldrick-Rab 2010). While often praised for remaining more affordable than other postsecondary options and offering a "second chance" at educational attainment (Rouse 1995), the community college has also been steadily attacked for low rates of bachelor's degree completion among the population it serves. Some have suggested that community colleges further socioeconomic disparities in education (Grubb 1991; Brint and Karabel

1989), and that students, especially those seeking bachelor's degrees, are best advised to avoid community college attendance entirely (Guess 2008).

The main explanation for these seemingly disparate judgments is that analysts have focused on different functions of the community college. On one hand, community colleges exist to provide some postsecondary education; on the other hand, they are also expected be an affordable and accessible gateway that facilitates access to baccalaureate-granting institutions via transfer. They appear to fulfill the first function fairly well and the second not as well (Belfield and Bailey 2011; Goldrick-Rab 2010; Grubb 1991; Leigh and Gill 2003; Roska 2009; Roska and Keith 2008). Indeed, in an attempt to focus on one function of community college—i.e., access to baccalaureate degrees—some analysts restrict their samples to students with the stated intent to attain a bachelor's degree (Alfonso 2006; Doyle 2009; Leigh and Gill 2003; Long and Kurlaender 2009; Whitaker and Pascarella 1994). This approach treats educational expectations, which are known to be malleable and fluctuating (Morgan 2005; Reynolds et al. 2006), as static and decisive. Limiting variation among students may also truncate the range of estimated effects of attendance.[1]

There are further methodological and theoretical considerations that may play into the seemingly incompatible interpretations that past research accords to the effects of community college attendance. The interpretation of the community college effect most commonly estimated by analysts is complicated if there is effect heterogeneity (Brand 2010; Brand and Simon Thomas 2013; Brand and Xie 2010; Morgan and Winship 2014; Xie, Brand, and Jann 2012). Community college attendance may yield positive effects for some subpopulations and negative effects for others. First, the estimated effect of community college should differ according to the assumed counterfactual educational choice, whether it be no postsecondary education or attendance at a non-selective or selective four-year college following high school. This distinction underscores prior discussions of the divergent functions of the community college, but it is more complex than that, as it requires precisely identifying how choice sets differ across the population. Community college attendance may *increase* access to educational attainment among disadvantaged students relative to their most likely counterfactual—no immediate college attendance (Roderick, Coca, and Nagaoka 2011; Rouse 1995; Sandy, Gonzalez, and Hilmer 2006). That is, if a large segment of the community college population would otherwise have no immediate postsecondary education rather than attend a four-year college, then scholars overstate the penalty to community college attendance by comparing community college students only to four-year college goers. But community college attendance could *simultaneously* decrease bachelor's degree completion among advantaged students, whose probable counterfactual would be postsecondary education at a four-year college. Among community college goers, the size of the disadvantaged population is likely larger than the size of the advantaged. Moreover, the majority of community college goers who could have otherwise attended a four-year college would have attended a non-selective four-year institution. Colleges of different levels of selectivity present disparate opportunities for students, particularly among more disadvantaged students characteristic of community college goers (Alon and Tienda 2005; Brand and Halaby 2006; Dale and Krueger 2011). Thus, studies analyzing community college effects only among college goers (e.g., Doyle 2009; Long and Kurlaender 2009; Reynolds and DesJardins 2009; Whitaker and Pascarella 1994) set aside the demonstrably relevant counterfactual of no college attendance, while others aggregate institutional types and mask the variable effects of different kinds of colleges (e.g., Alfonso 2006; Doyle 2009; Kane and Rouse 1995; Leigh and Gill 2003; Rouse 1995; Sandy, Gonzalez, and Hilmer 2006). It is notable given the diversion versus democratization debate in the literature how few studies simultaneously consider both alternatives.

Recent research has attended to the potential outcomes associated with community college attendance and has adopted a propensity score framework to estimate effects (Doyle 2009;

[1] Other studies have gone further in an effort to identify "true" comparison groups. For example, Melguizo, Kienzl, and Alfonso (2011) compare the college outcomes of community college transfer students and rising juniors from four-year colleges. It is perhaps unsurprising that they find no negative community college effect, since theirs is, rather than a community college effect, the effect of being a community college transfer student—a selective and high achieving group of community college attendees.

Long and Kurlaender 2009; Kalogrides and Grodsky 2011; Melguizo, Kienzl, and Alfonso 2011; Reynolds 2012; Reynolds and DesJardins 2009), but this research does not attend to the possibility that the estimated effect may differ across subpopulations. As in the vast majority of such studies, these estimate average treatment effects and assume away effect heterogeneity. Long and Kurlaender (2009) and Rouse (1995) use instrumental variable (IV) models to estimate community college effects, where distance to college is the instrument.[2] They find smaller community college penalties using IV models relative to OLS regression or propensity score models and suggest that this is the result of unobserved heterogeneity. However, if there is effect heterogeneity, then IV estimates should be interpreted as local average treatment effects (LATE) that pertain to the population induced to attend community college by distance, and not to the total population of community college goers. Neither Long and Kurlaender (2009) nor Rouse (1995) interpret estimated effects as heterogeneous, pertaining to a subpopulation of community college students defined according to selection into treatment.[3] Yet relating differential effects of community college attendance to the probability that students attend community college yields important insights about how educational resources are distributed in society and the potential impact of increasing or decreasing the population of community college attendees (Brand and Xie 2010; Heckman et al. 2006).

[2]Distance to college is an invalid instrument if it affects four-year degree completion directly, rather than only indirectly through community college attendance. Indeed, proximity to four-year colleges increases the likelihood of attending four-year colleges; it is frequently used as an instrument in studies of the effects of four-year college attendance (e.g., Carneiro, Heckman, and Vytlacil 2011).

[3]The subpopulation induced into treatment, which cannot actually be identified, can differ on both observed and unobserved characteristics from the treated and the untreated populations. The TT is a combination of the effect for individuals induced by the instrument (so-called "compliers") and that for individuals who are treated regardless of the inducement ("always-takers"); likewise, the TUT is a combination of the effect for compliers and for individuals untreated regardless of the inducement ("never-takers"). Since an IV is not directly informative about effects on always-takers and never-takers, instruments do not usually capture the average causal effect on all of the treated or on all of the non-treated (Angrist and Piscke 2009). Moreover, those induced into treatment can differ as the inducement changes, because different instruments will affect treatment status for different segments of the population (Angrist and Pischke 2009; Brand and Simon Thomas 2013; Gangl 2010).

Analytic Methods

For individual i, the effect of community college is defined as the difference between the potential outcome (in this case, bachelor's degree completion) in the community college state (i.e., the treated state, $d=1$) and the non-community college state (i.e., the control state, $d=0$) (Morgan and Winship 2014):

$$\delta_i = y_i^{d=1} - y_i^{d=0}. \quad (1)$$

Thus we ask whether students who started at a community college within a year of high school graduation ($d = 1$) have different outcomes than they otherwise would have had if they had not begun their postsecondary career by enrolling in a community college ($d = 0$). It is, of course, impossible to observe both outcomes for the same individual. If unobserved characteristics affect decisions to attend community college and these characteristics are also correlated with eventual bachelor's degree completion, then the estimated effects of community college will be biased. The selection on observables assumption can never be verified and should not be taken as true in practice for observational data; its plausibility depends upon the population under study and the availability of observed covariates. Measurement of meaningful confounders renders ignorability tentatively more plausible, though still not necessarily true. However, such analyses offer the most the data can tell us without additional unverifiable assumptions, such as those imposed by an IV approach. Recent studies of the community college effect have recognized the challenges inherent in establishing the causal effects of community college attendance with observational data (Doyle 2009; Long and Kurlaender 2009; Reynolds 2012; Rouse 1995).

We decompose the baseline counterfactual, no community college attendance, into a multistate treatment condition, which entails a series of choice equations comparing community college attendance to control states defined by educational alternatives within a year of high school graduation: (1) no postsecondary schooling; (2)

attendance at a non-selective four-year college; (3) attendance at a selective four-year college; and (4) attendance at a highly selective four-year college.[4] Each of these treatment categories itself represents a complex treatment that could be further decomposed according to attendance patterns at later points in time. The no postsecondary schooling (within one year of high school completion) category includes individuals who never attended, as well as those who later went on to attend community and four-year colleges. Likewise, the various attending categories include students who start out at four-year colleges and who subsequently attend a variety of different colleges over their postsecondary career, including community colleges (i.e., "reverse transfer" students, see Goldrick-Rab and Pfeffer 2009).[5]

We estimate a series of binary logit models for the probability of selection into our multistate treatment. Binary logit (or probit) equations are well developed in the matching literature, enable simple tests for common support and balance of covariates, and do not impose the independence of irrelevant alternatives (IIA) assumption required for a multinomial model. Although the multinomial approach benefits from formulating the complete set of alternatives in one model, derived conditional probabilities are not interdependent in binary models. As misspecification of one choice equation yields misspecification of all the conditional probabilities in the multinomial model, binary choice series estimation is potentially more robust than the multinomial approach (Lechner 2001).

We begin by estimating simple bivariate associations, or unmatched mean differences, for the treatment-control states. We then estimate effects using propensity score matching, where individuals are matched according to their propensity for community college attendance relative to each alternative (Morgan and Harding 2006). The primary advantage of matching compared to conventional regression models is conceptual. The conditions under which valid causal inference can be had is a central focus in matching routines, including precisely defining the counterfactual conditions and assessing covariate balance between treated and untreated cases. We estimate propensity scores with a logit regression of the following form that predicts the propensity of going to community college:

$$P_i = p(d_i = 1|X) = \ln \frac{d_i}{1 - d_i} = \left(\sum_{k=0}^{K} \beta_k X_{ik} \right) \quad (2)$$

where P is the propensity score; d_i indicates whether individual i $(i = 1, \ldots, n)$ attends community college or each of the four alternatives; and X represents a vector of observed pre-treatment covariates, described in more detail below. These propensity scores represent estimates of individual likelihoods of attending community college relative to each alternative. The community college effect is the difference in bachelor's degree completion between students with comparable propensities.

We can define treatment effects over several population subsets; we estimate the average treatment effect on the treated (TT):

$$E(\delta|d = 1) = E(y^{d=1} - y^{d=0}|d = 1) \quad (3)$$

All matching estimators of the TT take the following general form:

$$TT = \frac{1}{n_1} \sum_{i}^{n_i} \left(y_{i,d=1} - \sum_{i(j)}^{iJ} W_{i(j)} y_{i(j),d=0} \right), \quad (4)$$

where n_1 is the number of treatment cases; i is the index over treatment cases; $i(j)$ is the index over untreated cases for treated case $i(i(j) = 1, \ldots, i(J)$; and $w_{i(j)}$ is the scaled weight (with sum of one) that measures the relative importance of each untreated case.[6] Scholars have not

[4] College selectivity is defined by *Barron's Profiles of American Colleges* (2003), which categorizes colleges according to SAT scores, grade point average, class rank required for admission, and overall admissions acceptance rate. Colleges in the top two categories of Barron's Profiles, "Most Competitive" and "Highly Competitive," are considered highly selective for our purposes.

[5] Future research that aims to more fully attend to the complexity of student postsecondary pathways may still need to engage in empirical reduction (e.g., through latent class or sequence analysis) to identify a manageable and meaningful set of common attendance patterns. This is beyond the scope of the current study.

[6] Prior research using a regression framework estimates *ATE*s only if the assumption of effect homogeneity is true. That is, from our reading, no subpopulation weights are

reached a consensus as to which matching estimator performs best in each application, although nearest neighbor (with replacement) and kernel matching, which we use here, perform well in simulations (Morgan and Harding 2006; Morgan and Winship 2014). Morgan and Winship (2014) and Morgan and Harding (2006) advise researchers to examine multiple estimates of the same treatment effect to establish a degree of robustness for the results.

In auxiliary analyses, we describe how the various estimated effects of community college attendance correspond to the estimated propensity for community college attendance. By revealing how effects differ among subpopulations defined according to their selection into treatment, we shed light on a central sociological question about the distribution of individual opportunities. Another advantage is the heightened recognition of potential violations of the selection on observables assumption across the population distribution (Brand and Simon Thomas 2013). That is, one interpretation of variation in effects involves differential selection mechanisms on unobserved variables. We consider variation in community college effects by the propensity for community college attendance using a nonparametric method, the "smoothing-differencing" method (SD). SD consists of the following three steps (Xie, Brand, and Jann 2012): (1) estimate propensity scores for each unit; (2) fit separate nonparametric regressions of the dependent variable on the propensity scores for the treated and untreated groups by local polynomial smoothing (degree 1, bandwidth 0.2); and (3) take the difference in the nonparametric curves between the treated and the untreated to obtain the pattern of treatment effect heterogeneity as a function of the propensity score. The SD method allows for heterogeneous treatment effects as a continuous function of the propensity score that we then relate to the effects estimated across the alternative counterfactual conditions.

applied. If there is effect heterogeneity, the treatment effect in such models is neither a TT nor an ATE, but a particular weighted average lacking a direct analog to the ATE or TT (or TUT) (Elwert and Winship 2010). Past research using an IV framework yields local average treatment effects ($LATE$), which are also not directly comparable to either the TT or ATE.

Data and Sample

Decisions about attending community colleges are essentially local ones; very few students travel far from home to attend. The same is generally true for students attending non-selective, public four-year institutions (Goldrick-Rab 2010; Turley 2009). In large national samples with wide variation among students and colleges, this local concentration can lead to confusion between treatment heterogeneity and treatment *effect* heterogeneity (i.e., different effects of attending community colleges with different characteristics versus different effects of community colleges for different students, respectively). Thus, examining heterogeneous effects of community colleges with national or state samples complicates the interpretation of effects relative to considering how attending a specific community college (or set of colleges) exerts heterogeneous effects on the students it aims to serve. Heckman, Ichimura, and Todd (1997) emphasize the importance of comparing treatment and control groups in the same social and economic environment to minimize bias, a consideration that national samples clearly do not meet. With an eye toward addressing these issues, we estimate effects of attending the Chicago City Colleges for the graduates of Chicago Public Schools on bachelor's degree completion.[7] The tradeoff is, of course, that we have limited ability to generalize estimates of effects beyond Chicago and to students who attend private high schools.

We focus on Chicago because it is among a handful of urban school districts that has for many years followed the trajectories of their graduates and collected data on students' background characteristics and schooling. Chicago also represents the nation's fourth largest school district. Nearly half of students in Chicago Public Schools (CPS) enroll in college within one year of high school, and half of those students (24 percent of the sample) enter a college granting bachelor's degrees. More than half of all CPS college goers

[7] City Colleges of Chicago is a network of seven institutions with the same tuition and fees, serving a clientele that is more than 70 percent racial and ethnic minorities. First-year freshman retention rates range from 40 to 60 percent (`www.college-insight.org`). According to IPEDS data from 2009–2010, enrollment ranges from roughly 5,000 to 13,000 students, with five of the seven colleges having 7,000 to 9,000 students.

enroll in ten in-state colleges, most of them located within Chicago city limits. Among those attending four-year colleges, most are enrolled at schools with graduation rates well below the national norm (Roderick, Coca, and Nagaoka 2011).[8] The bachelor's degree completion rate within six years of high school is about 11 percent, low by nearly any standard. This is not entirely surprising, given the students' relatively poor academic qualifications and high level of socioeconomic disadvantage (Roderick at al. 2008).

Data on students' pre-college characteristics come from CPS and the surveys conducted by the Consortium for Chicago School Research (CCSR). We utilize a wide range of measures affecting college choice. These include:

1. *demographic characteristics* (sex, race and ethnicity, citizenship, generational status)
2. *social background characteristics* (family structure, mothers' education, Census tract social status according to occupation and education, Census tract unemployment and poverty, and Census tract homeowner tenancy)[9]
3. *high school academic achievement* (cumulative grade point average, number of honors courses, number of AP courses, number of absences, placement in special education)
4. *educational resources* (number of educational resources at home, parental communication parental involvement);
5. *educational aspirations and expectations* (college aspirations, college expectations, and parental expectations for college)
6. *high school characteristics* (percentage of students who proceed to a four-year college)

With the notable absence of measures of cognitive ability and direct measures of family income (we have only indirect indicators through neighborhood characteristics), ours is a more extensive set of covariates than is typically employed in studies of community college choice. For example, due to limitations in the Ohio administrative source they employed, Long and Kurlaender (2009) only conditioned on a subset of potentially observable characteristics, and only for a select group of students (i.e., those who had taken the ACT and aspired to complete a bachelor's degree). Since the ACT is not required for admission to community college, theirs is an especially selective sample of students that excludes students who wanted to earn a bachelor's degree but did not adequately prepare (a common phenomenon in Chicago; see Roderick et al. 2008) or did not state while in high school an aspiration to earn that degree.

We estimate community college effects for the class of 2001 cohort of CPS graduates. Most analyses estimating community college effects include samples of much older cohorts (Goldrick-Rab 2010). We use a more recent cohort of graduates who nonetheless graduated from high school prior to contemporary reform efforts to increase college attendance in Chicago. We estimate effects on college completion within six years of high school graduation. Six years is 150 percent of the time typically needed to complete a four-year degree as a full-time student and is commonly used in the higher education literature to calculate graduation rates. Seventy-six percent of bachelor's degree recipients nationally complete their degree within six years (National Center for Education Statistics 2009). Still, students who delay college entry and those who enroll part-time may not reasonably complete their degrees within six years, and thus the community college penalty is likely overstated by applying a six-year completion restriction.[10]

[8]The most popular community colleges for CPS students are the Wilbur Wright, Richard J. Daley, and Harold Washington City Colleges. The most popular four-year colleges are the University of Illinois at Chicago (highly selective), Northeastern Illinois University (non-selective), the University of Illinois at Urbana-Champaign (highly selective), Chicago State University (selective), Northern Illinois University (selective), Columbia College of Chicago (non-selective), and Southern Illinois University at Carbondale (selective).

[9]Neighborhood social status is the standardized mean of the percentage of persons 16 years old or older who are managers and executives in a Census block and the (logged) mean level of education among people older than 18 years. Neighborhood unemployment and poverty is based on the percentage of males over 18 who were employed one or more weeks during the year and the percentage of families above the poverty line in a Census block. Neighborhood homeownership is the average number of years of tenancy of homeowners in the census block.

[10]The National Center for Education Statistics uses twelve months as the established time to begin postsec-

We condition our initial sample of CPS graduates (N=14,322) on data availability; specifically, students must be included in the National Student Clearinghouse data (N=13,966) and have responded to at least one of the surveys administered by CPS in grades 9 and 11 (N=9,533). We also exclude a small number of students who attended private two-year colleges (46 students, or 0.3 percent), and students attending four-year institutions of unknown selectivity (247 cases, or 1.7 percent).[11] Missing information on survey measures is imputed using all other variables in our models. We present results based on one imputed dataset, but note that the prediction results for the propensity score are stable to using ten imputed datasets (results available from the authors upon request).[12] Departing from some past research (e.g., Alfonso 2006; Doyle 2009; Leigh and Gill 2003; Long and Kurlaender 2009; Whitaker and Pascarella 1994) we do not condition the sample on the stated aspiration to earn a bachelor's degree, for the reasons we describe above.[13] Instead, we advance comparability between treated and control groups by examining a local setting, conditioning on a rich set of exogenous covariates, restricting our analyses to regions of common support (i.e., no significant covariate or propensity score differences between treated and control groups), and estimating effects to specific subpopulations based on alternative counterfactual conditions.

Results

Descriptive Statistics

College-bound students face many options in Chicago, including more than fifty four-year colleges and universities (both selective and non-selective), and a system of seven community colleges. From Table 1, we observe that characteristics of community college students are most similar to individuals who do not attend postsecondary education immediately following high school. Some variables suggest that students who do not continue their schooling are more disadvantaged than community college goers; i.e., students who do not continue schooling are more likely to be racial and ethnic minorities, live in more disadvantaged communities during high school, and have lower educational aspirations and expectations. Still, with the exception of race, the differences between community college goers and non-college goers are smaller than the differences between community college goers and four-year college goers. Compared to four-year college goers, community college students have less educated mothers, more often live in non-intact families, reside in substantially more disadvantaged parts of the city, have lower educational aspirations and expectations, and have lower academic achievement in high school (i.e., attain lower GPAs, take fewer honors courses and AP classes, and are absent more often). As expected, these differences are largest between community college goers and highly selective four-year college goers.

College choice is associated with the likelihood of bachelor degree completion for CPS graduates.

ondary schooling without delay. Nationally, median time to bachelor's degree is about four years for those pursuing postsecondary schooling without delay, and seven years for those delaying beyond twelve months.

[11] Given the low share of these combined cases (2.2 percent of CPS graduates for 2001) and the absence of strong arguments why this particular kind of omission should be related to our outcome of interest, we consider it unlikely that this exclusion biases our estimates.

[12] We have complete data for basic demographic characteristics and a negligible share of missing information for a handful of variables, such as Census Tract information (0.3 percent), high school's college going rate (0.7 percent), and students' high school GPA, number of honors classes, and AP credits (2.0 percent). Only our survey measures have a significant share of missing information, but the reliability of these imputations is maximized by using 9^{th} grade survey information to impute for missing 11^{th} grade survey information (i.e., we retain students who did not respond to the 11^{th} grade survey but did provide information on the same questions in the 9^{th} grade; N=3,977). Those not responding to any survey are more likely to be male, Hispanic, and from a less advantaged neighborhood.

[13] While we do not eliminate from the sample those who have stated they do not intend to obtain a bachelor's degree, we do compare indivduals with similar expectations and aspirations during secondary school. While educational expectations are malleable and should not define the sample, they may indicate similar personality characteristics or ambitions that predict college pathways and could bias observed relationships between community college attendance and bachelor's degree completion. However, as these variables are potentially endogenous, we have also estimated our main analyses without conditioning on college aspirations and expectations as a sensitivity test. We find that conditioning has no substantive impact upon our results. These results are available from the authors upon request.

Table 1: Descriptive Statistics by Educational Path: Chicago Public Schools Sample

		Status Within One Year of High School Completion				
			No Community College			
	Full Sample	Community College	No College	Non-Selective 4-year	Selective 4-year College	Highly Selective 4-year
Demographic Characteristics						
Female	0.591	0.609	0.553	0.622	0.657	0.638
White	0.126	0.131	0.089	0.164	0.123	0.231
Black	0.519	0.538	0.528	0.468	0.731	0.329
Hispanic	0.297	0.275	0.353	0.278	0.131	0.259
Other race	0.059	0.056	0.030	0.091	0.016	0.182
U.S. born	0.814	0.843	0.820	0.765	0.902	0.715
Second generation	0.396	0.406	0.380	0.442	0.189	0.571
Social Background Characteristics						
Intact family	0.438	0.407	0.411	0.472	0.378	0.606
Mother college graduate	0.218	0.195	0.167	0.231	0.300	0.360
Neighborhood social status	−0.235	−0.265	−0.357	−0.074	−0.025	−0.010
	(0.799)	(0.759)	(0.758)	(0.788)	(0.788)	(0.911)
Neighborhood non-poor	0.225	0.219	0.318	0.105	0.273	−0.070
	(0.799)	(0.826)	(0.764)	(0.829)	(0.819)	(0.774)
Neighborhood homeowner	11.402	11.513	11.150	11.133	12.747	11.276
	(4.199)	(4.244)	(4.034)	(4.131)	(4.733)	(4.126)
High School Academic Achievement						
Cumulative GPA	2.497	2.222	2.225	2.646	2.792	3.529
	(0.821)	(0.655)	(0.715)	(0.688)	(0.660)	(0.609)
Honors courses	0.792	0.382	0.460	0.845	1.188	2.205
	(1.330)	(0.909)	(1.025)	(1.322)	(1.484)	(1.595)
AP credits	0.145	0.044	0.078	0.105	0.148	0.539
	(0.495)	(0.253)	(0.362)	(0.408)	(0.469)	(0.879)
	6.323	6.939	7.439	5.342	4.846	3.176
	(6.393)	(6.605)	(6.992)	(5.152)	(4.556)	(3.857)
Special education	0.083	0.095	0.116	0.068	0.020	0.005
	(0.276)	(0.294)	(0.320)	(0.251)	(0.140)	(0.0728)
Educational Resources						
No. of educ. resources at home	5.298	4.928	4.809	5.553	6.317	6.630
	(3.038)	(3.004)	(3.012)	(2.949)	(2.889)	(2.723)
Parental communication	4.459	4.382	4.273	4.713	4.766	4.850
	(1.874)	(1.928)	(1.941)	(1.719)	(1.733)	(1.626)
Parental involvement	6.596	6.532	6.487	6.864	6.822	6.752
	(2.690)	(2.787)	(2.754)	(2.520)	(2.562)	(2.476)
Aspirations and Expectations						
College aspirations	0.446	0.407	0.323	0.527	0.626	0.752
College expectations	0.368	0.324	0.252	0.391	0.539	0.696
College expectations parents	0.934	0.950	0.905	0.955	0.975	0.970
High School Characteristics						
College-going rate	0.476	0.481	0.471	0.484	0.496	0.463
	(0.074)	(0.073)	(0.076)	(0.067)	(0.069)	(0.072)
Outcome						
Bachelor's degree completion	0.114	0.028	0.016	0.107	0.174	0.541
N	9,533	1,772	4,704	740	1,003	1,314

Notes: Numbers in parentheses are standard deviations for continuous variables. Sample restricted to CPS high school graduates.

As described in Table 1, 11.4 percent (N = 1,089) of graduates from the CPS class of 2001 earned a bachelor's degree by 2007. This figure includes 1.6 percent (N = 74) of students who did not attend postsecondary school within a year of their high school graduation, 2.8 percent (N = 50) of

students who started at a community college, 10.7 percent (N = 79) of students who attended a non-selective four-year college, 17.4 percent (N = 175) of students who attended a selective four-year college, and 54.1 percent (N = 711) of students who attended a highly selective four-year college. As we note above, this is a sample marked by high socioeconomic and academic disadvantage, and thus college completion rates are quite low relative to national averages.

Matching Analyses of Multistate Treatment Effects

To estimate effects of community college attendance on bachelor's degree completion, we match community college goers to non-community college goers (i.e., those who either started at four-year college or did not start at all within one year) who have similar propensities to attend.[14] We first estimate the propensity of a student to attend community college within one year of completing high school relative to: (1) not attending postsecondary education; (2) attending a non-selective four-year college; (3) attending a selective four-year college; and (4) attending a highly selective four-year college. The results, reported in Table 2, suggest that when comparing community college students to those who did not immediately pursue postsecondary schooling, high educational aspirations and high parental educational expectations predict community college attendance; by contrast, low educational aspirations, poor academic preparation, and family disadvantage are significant predictors of community college attendance relative to those who attended non-selective four-year colleges. When comparing community college students to those who attended selective four-year colleges, the former are more likely to be significantly disadvantaged with respect to family background, high school academic preparation, educational resources, and educational aspirations and expectations of students and parents. Relative disadvantages are larger still when comparing community college students to those who attended highly selective four-year colleges.

In Table 3, we report propensity score matching results of the treatment effects for the treated under each counterfactual scenario using several alternative matching algorithms. We restrict all analyses to the region of common support (α=0.01). As expected, this restriction results in the loss of very few cases for the comparisons most closely matched on observed characteristics (i.e., between community college and no immediate college or non-selective four-year college); we lose more cases when we compare community college goers to selective and highly selective four-year college goers. We do not find notable differences between our three matching methods.

Compared to students who attend four-year schools, community college students are less likely to complete a bachelor's degree. Matching estimates suggest a level of bachelor's degree completion roughly 5 percentage points lower for community college goers relative to students starting at a non-selective four-year college, but larger penalties (9 to 10 percentage points lower) relative to those attending a selective four-year college.[15] We observe a substantial community college penalty relative to attending a highly selective four-year college: we find a 41 percentage point difference using single nearest neighbor matching, a 35 percentage point difference using nearest neighbor matching with five controls, and a 31 percentage point difference using kernel matching. These estimates suggest that the students most penalized by attending a community college are those with more advantaged social backgrounds and better academic preparation. It appears these students would be particularly better served by attending a highly selective four-year school, as we would expect given the high graduation rates characteristic of selective colleges.

While we find penalties associated with community college attendance compared to attending a four-year college, we also find that community college goers are significantly more likely to ob-

[14] A naïve estimation of a community college effect (i.e., without attention to the range of alternative educational choices) that is based on a logistic regression of bachelor's degree completion on community college attendance and the full set of controls suggests that attending community college lowers the odds of completing a bachelor's degree by 63 percent. These results are reported in the first column of Table A.1 in the appendix.

[15] If we restrict attention to those students who obtain a bachelor's degree, over half of community college students graduate from highly selective colleges; only about 13 percent of students who begin at non-selective and selective four-year colleges graduate from highly selective colleges.

Table 2: Logistic Regression Estimates for Models Predicting Community College Attendance

	Community College Attendance vs.			
	No College	Non-Selective 4-year	Selective 4-year	Highly Selective College
Female	1.343*	1.158	1.317*	1.154
	(0.081)	(0.116)	(0.137)	(0.148)
Black	0.746†	0.903	0.368*	0.422*
	(0.087)	(0.166)	(0.070)	(0.099)
Hispanic	0.437*	0.662†	0.544*	0.391*
	(0.048)	(0.114)	(0.111)	(0.082)
Other race	1.205	0.812	2.158†	0.475*
	(0.200)	(0.177)	(0.728)	(0.116)
U.S. born	1.752*	1.719*	1.530†	1.406
	(0.169)	(0.266)	(0.292)	(0.246)
Second generation	1.887*	1.451†	2.592*	1.054
	(0.184)	(0.236)	(0.462)	(0.209)
Intact family	0.974	1.023	1.173	1.185
	(0.066)	(0.112)	(0.132)	(0.163)
Mother college graduate	1.071	1.011	0.925	0.865
	(0.084)	(0.123)	(0.108)	(0.126)
Neighborhood social status	1.003	0.678*	0.760*	0.826†
	(0.047)	(0.052)	(0.063)	(0.075)
Neighborhood non-poor	0.838*	0.899	0.934	0.950
	(0.041)	(0.070)	(0.075)	(0.095)
Neighborhood homeowner	1.015†	1.027†	0.993	1.028
	(0.007)	(0.012)	(0.011)	(0.016)
HS GPA	0.940	0.430*	0.278*	0.084*
	(0.050)	(0.038)	(0.026)	(0.011)
HS honors courses	0.894*	0.896†	0.820*	0.754*
	(0.032)	(0.043)	(0.039)	(0.037)
HS AP credits	0.675*	1.047	0.936	0.799
	(0.076)	(0.153)	(0.135)	(0.102)
HS absences	0.988*	1.008	1.025*	1.015
	(0.005)	(0.009)	(0.010)	(0.013)
HS special education	0.827	1.021	3.192*	3.769*
	(0.082)	(0.185)	(0.830)	(1.742)
Educ. resources	0.978	0.964	0.881*	0.862*
	(0.012)	(0.019)	(0.018)	(0.022)
Parental communication	1.028	0.936	0.982	0.950
	(0.024)	(0.038)	(0.041)	(0.048)
Parental involvement	0.992	1.022	1.071†	1.141*
	(0.016)	(0.029)	(0.031)	(0.041)
College aspirations	1.288*	0.675*	0.685*	0.707†
	(0.100)	(0.081)	(0.086)	(0.110)
College expectations	1.143	1.112	0.741†	0.401*
	(0.093)	(0.140)	(0.094)	(0.062)
College expectations (parental)	1.841*	1.183	0.847	1.077
	(0.228)	(0.265)	(0.225)	(0.333)
HS college-going rate	2.813†	1.073	0.840	6.688†
	(1.212)	(0.793)	(0.633)	(6.146)
Constant	0.089*	10.620*	94.290*	1830.452*
	(0.027)	(5.567)	(53.303)	(1284.507)
$LR\chi^2$	297.8	296.4	936.4	2325.3
$P > \chi^2$	0.000	0.000	0.000	0.000
N	6,476	2,512	2,775	3,086

Notes: Odds ratios reported. Numbers in parentheses are standard errors. Sample restricted to CPS high school graduates.

† $p < .05$ $p < .01$ (two-tailed tests).

Table 3: Matching Estimates of Community College Attendance on College Completion

	Comparisons of Status Within One Year of HS Completion			
	CC vs. No College	CC vs. Non-Selective 4yr	CC vs. Selective 4yr	CC vs. Very Selective 4yr
Unmatched Differences	0.012*	−0.079*	−0.146*	−0.513*
	(0.004)	(0.010)	(0.010)	(0.013)
Nearest Neighbor Matching ($k = 1$)	0.016*	−0.050*	−0.100*	−0.409*
	(0.005)	(0.020)	(0.027)	(0.093)
Nearest Neighbor Matching ($k = 5$)	0.013*	−0.058*	−0.092*	−0.348*
	(0.005)	(0.017)	(0.024)	(0.075)
Kernel Matching	0.012*	−0.053*	−0.091*	−0.307*
	(0.004)	(0.015)	(0.022)	(0.061)
N (on common support)	6,471	2,512	2,675	3,008
% cases lost	0.1	0.0	3.6	2.5

Notes: Mean differences between control and treatment group reported. Numbers in parentheses are standard errors. Propensity scores were estimated by logit regression models of community college attendance on the set of pre-college covariates as described in Table 2. Sample restricted to CPS high school graduates.

* $p < .01$ (two-tailed tests.

tain a bachelor's degree relative to students who do not immediately pursue postsecondary schooling. Nearest neighbor and kernel matching estimates suggest a level of bachelor's degree completion that is 1.3 to 1.6 percentage points higher—a modest point increase but a large increase in the odds given the low levels of bachelor's degree completion among this population. Thus, community college attendance yields both a large penalty relative to attendance at a four-year college, particularly a highly selective one, in addition to a modest benefit relative to no immediate postsecondary schooling.[16] In analyses available upon request we construct Rosenbaum bounds to assess the sensitivity of our results to different levels of unobserved biases (i.e., different assumed relationships between potentially unobserved variables and the treatment). Unobserved factors that double the odds of attending community college would render non-significant the positive effects of attending compared to not immediately pursuing postsecondary education. The negative effect of attending community college compared to a four-year college is not sensitive to additional unobserved factors that would (at least) triple the odds of going to a community college. This finding may be unsurprising given the large size of these negative treatments effects; however, we must bear in mind that these comparisons are certainly the most susceptible to violations of the selection on observables assumption.

[16]If we drop all those students who attend selective colleges from the simple regression models reported in the first column of Table A.1 in the appendix, we eliminate the negative effect of community college attendance on bachelor's degree completion. We report these results in the second column of Table A.1.

Auxiliary Analyses of Effect Heterogeneity

In Table 4, we decompose the counterfactual condition by propensity score strata, in order to assess the likelihood of each of the alternative counterfactual conditions for the typical community college goer. We generate these propensity score strata by obtaining predicted values based on a logistic regression model predicting community college attendance relative to no community college attendance (i.e., both non-attendance and four-year college attendance). Among individuals with a high propensity for community college attendance but who did not attend community college, the majority did not enroll in any college within one year of high school graduation. In

Table 4: Decomposition of Community College Alternatives by Strata-Specific Propensity for Community College Attendance

Stratum (propensity score)	1 (0-.05)	2 (.05-.075)	3 (.075-.1)	4 (.1-.15)	5 (.15-.2)	6 (.2-.25)	7 (.25-.6)
Status Within One Year of HS							
No College	0.246	0.270	0.388	0.569	0.642	0.719	0.813
Non-Selective 4-Year	0.060	0.076	0.089	0.096	0.111	0.098	0.098
Selective 4-Year	0.112	0.187	0.186	0.144	0.151	0.134	0.056
Highly Selective 4-Year	0.582	0.467	0.336	0.192	0.096	0.050	0.033
N	552	540	515	1,357	1,683	1,557	1,518

Note: Sample restricted to CPS high school graduates. Strata are based on community college versus no community college analysis.

other words, for the majority of community college goers, the alternative to community college attendance is not to go to college; the treatment effects reported in the first column of Table 3 therefore correspond to the largest proportion of the community college population. Among students with a low propensity for community college attendance but who did not attend community college, we find proportionately higher levels of four-year college goers. The selectivity of four-year degree attendance increases as the propensity for community college attendance decreases. Thus the treatment effects reported in the second through fourth columns of Table 3 correspond to a smaller population of community college goers.

To examine effects across the propensity for community college attendance, we fit separate nonparametric regressions of bachelor's degree completion on the propensity score for the treated and control groups and take the difference in the curves. The x-axis in Figure 1 plots the continuous propensity score and the y-axis the differences in nonparametric regressions between treated and controls—i.e., the treatment effect using the smoothing-differencing heterogeneous treatment effects method described in Xie, Brand, and Jann (2013). We find a curvature in the trends in effects, with a negative effect for low-propensity individuals, leveling off to no effect in the middle of the propensity distribution.[17] This result further demonstrates that the large negative effect of community college attendance is only relevant for the relatively small population of community college goers with a low propensity for attendance.

Discussion and Conclusions

The interpretation of community colleges' role in stratification processes depends on the accurate assessment of the colleges' effects on educational attainment. We have shown that a thorough understanding of community college effects requires a clear specification of the likely alternatives to attending community college for various subpopulations. With rich survey and administrative data from Chicago Public Schools, we use propensity score matching to study community college

[17] We also estimate effects within strata (level-1) and then the trends in effects (level-2) (using the stratification-multilevel heterogeneous treatment effects method described in Xie, Brand, and Jann (2013)). We find a significant positive level-2 slope, indicating that the effect of community college increases (the negative effect decreases) as the propensity for community college attendance increases. The effect of attending community college compared to not attending community college on bachelor's degree completion is significant in the low propensity score strata, with as much as a 44 percent decrease in bachelor's degree completion in stratum 1, but insignificant in the high strata. We also test a quadratic term for level-2, and find a significant curvature to the trend in effects. That is, we find that the negative effect of community college attendance on four-year degree completion decreases (becomes less negative) as the propensity for community college increases, and then flattens to no effect in the middle of propensity score distribution.

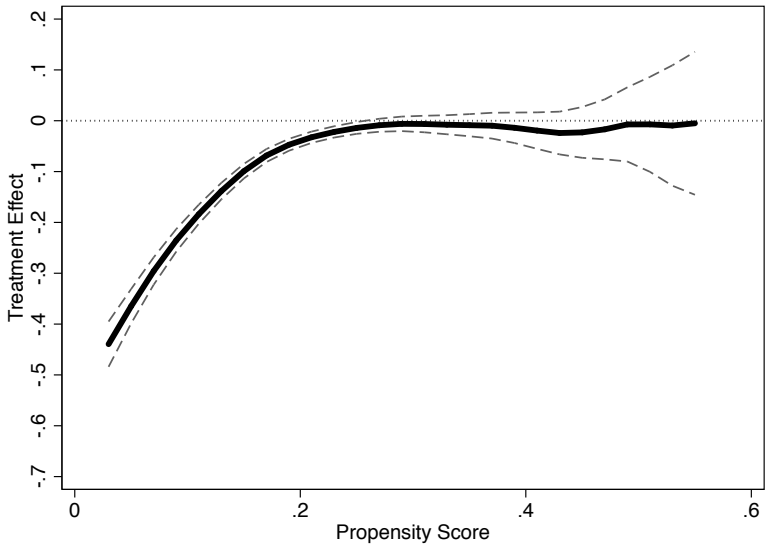

Figure 1: Heterogeneous Community College Effects on Bachelor's Degree Completion

effects. Some scholars have expressed the potential for heterogeneous treatment effects, and we rigorously test for their presence. We find that attending to the complexity of the counterfactual condition and how alternatives correspond to the propensity for community college yields a more accurate portrait as to who is penalized and who benefits from attending community college. The penalty to community college attendance is largest among students who would have attended selective four-year schools—students with advantaged social backgrounds and strong academic preparation, who have a low propensity for community college attendance. By contrast, community college attendance increases the likelihood of bachelor's degree completion among students who otherwise would not have attended college at all—students with disadvantaged social backgrounds and poor academic preparation, who have a high propensity for community college attendance and represent the majority of the community college population. Without attention to such heterogeneity, researchers sweep aside violations to the ignorability assumption that influence the results, especially for particular subpopulations, and in this case overstate the negative aggregate effect of community college attendance. Indeed, the widespread notion of a negative community college effect is feasibly driven by the unacknowledged violation of the selection on observables assumption inherent in past results comparing community college goers to attendees of selective four-year colleges.

A few caveats are in order. First, we focus on a single urban context. Although doing so potentially increases the internal validity of our results, our findings may nevertheless not generalize to other areas of the United States. The Chicago Public Schools and City Colleges serve especially disadvantaged populations and both are widely known for their challenges with regard to funding and leadership. Second, the accuracy of our estimates hinges on whether we have captured all relevant observables that predict community college attendance and bachelor's degree completion. The assessment of variation in effects by the counterfactual condition could by biased as a result of unobserved selection if such selection differs systematically across the distribution of groups and influences degree completion. As we note above, the bias is ostensibly largest when attendance is an unlikely event—i.e., for the comparison between community college goers and those who attend highly selective schools, in which we find the largest penalty to community college attendance. Indeed, the disaggregation of alternative counterfactual paths and its relation to the estimated propensity for community college

attendance highlights the contrasts for which we may expect the largest selection biases to operate. Third, we examine only one outcome: bachelor's degree completion. Community colleges serve many functions for a diverse population of students. Even those students who we discuss as being penalized because they did not complete a four-year degree may nevertheless have benefited from community college attendance in the labor market, in the marriage market, in their social-psychological wellbeing and self-acceptance, in their social involvement, and in other outcomes that indicate life chances (Hout 2012; Rose 2012). Future research should continue to explore the broader impact of community college attendance while attending to heterogeneity in effects.

Having made these cautionary statements, we believe our findings have important implications for policymakers, practitioners, and researchers in higher education. Assuming a homogenous community college effect masks variation in effects across the distribution of college goers. Our analyses suggest that accurately describing the role that community colleges play in social stratification requires analyzing effect heterogeneity and the processes through which heterogeneity arises. We find a penalty to community college attendance for advantaged students who have a low propensity for community college and might have instead attended a selective college. Thus while it may be true that some students would be better served by attending four-year rather than two-year colleges, our analyses suggest that relatively few students would have done so. Still, in the current era of widespread economic distress facing families alongside rising college tuition costs, we may find an increasing number of students who attend community rather than four-year colleges, even highly selective ones. We cannot predict, however, that this trend will entail a greater number of students facing a penalty from attending community college, given considerable concern over selection bias for this population comparison, and since a shift in the population composition of community college students could coincide with a corresponding shift in effects. Conversely, we find a modest benefit to community college attendance among disadvantaged students who have a high propensity for community college and for whom attendance at a four-year school was improbable. Indeed, the most likely alternative to community college attendance is no immediate college attendance. Discussions among academics and policy analysts should move beyond broad characterizations of the community college as a site of lost opportunities to addressing the ways in which we can ensure that these schools are equipped to serve the large numbers of students for whom they are the main and best option.

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