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The Bridge and the Troll Underneath: Summer Bridge Programs and Degree Completion

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College graduation rates in the United States are low in both real and relative terms. This has left all stakeholders looking for novel solutions while perhaps ignoring extant but underused programs. This article examines the effect of "summer bridge" programs, which have students enroll in coursework prior to beginning their first full academic year, on associate's and bachelor's degree completion. We make use of the Beyond Postsecondary (BPS) transcript data as well as data from one large university system. Our analysis utilizes propensity score matching to account for selection effects among students. We find that at community colleges and less selective 4-year colleges, students who attend bridge programs are 10 percentage points more likely to finish within 6 years. We discuss our findings in the context of how colleges might better use their existing initiatives to improve student outcomes, and in light of recent findings from a randomized controlled trial study.

Introduction

Degree completion rates in American higher education are low by any metric. A nationally representative, longitudinal study found that only 26% of degree-seeking undergraduates who started at a 2-year or community college and 63% of students who began at a 4-year college had completed a degree within 6 years (Radford et al. 2010). These rates are lower than those reported for other countries (OECD 2011) and are viewed by policy makers as a hindrance to our nation's economic competitiveness (Complete College America 2011; Kanter et al. 2011). Consequently, academic administrators and policy makers

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seek programs, interventions, and reforms that hold the promise of improving retention and graduation at the college level.

In this article, we examine bridge programs that enroll students during the summer between high school graduation and their first regular term of college to determine whether they improve students' retention and chances of degree completion. Bridge programs currently enroll only a small minority of undergraduates. In the nonselective colleges where they are most commonly found, fewer than 8% of entering undergraduates enroll in bridge programs, or over 200,000 undergraduate students each year, as we will document below. Thus, bridge programs represent a potentially untapped resource—something colleges already have in their architecture—that could be broadened to boost outcomes.

Do summer bridge programs improve retention, and do the students who attend them graduate in higher numbers as a result? We address these questions by analyzing two types of data. The first consists of transcript data from a nationally representative survey of undergraduates that tracked about 15,000 students from 2004 until 2009. We employ statistical methods to correct for the fact that undergraduates who enroll in bridge programs differ in certain respects from their fellow students. After correcting for this kind of selection bias, we find that students who enroll in bridge programs at relatively unselective colleges have about a 10-percentage-point higher graduation rate after 6 years than otherwise similar peers who do not. This suggests that bridge programs may indeed be a valuable tool for improving students' chances of graduating.

We also analyze recent data from a multicampus community college system that tracked about 10,000 undergraduates from 2010 until 2012. This second data set provides details unavailable in the national data that illuminate mechanisms through which enrollment in a bridge program improves early student progress. It also reveals a potential limitation to the efficacy of bridge programs. Rather than being an unqualified good, it may be the case that bridge programs are only contextually beneficial, insofar as they provide a means of

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avoiding other institutional hurdles. Thus, what matters may not be the bridge program in and of itself but rather the benefit of the safe passage that it provides.

Previous Research

Perspectives on Degree Completion

There is a very large literature on undergraduate retention and degree completion in general (Bean and Metzner 1985; Bowen et al. 2009; Bozick 2007; Braxton 2000; Dynarski 2003; Goldrick-Rab and Roksa 2008; Hoxby 2004; Nora et al. 2005; Seidman 2005; Tinto 1993; Turner 2004). One perspective emphasizes the importance of the academic and social integration of students, arguing that a mismatch between student abilities and interests and the institution plays a central role in dropping out (Tinto 1993, 1997). Other researchers attribute low completion rates to students' economic and demographic circumstances, citing delays in entering college (Horn et al. 2005), conflicting family obligations, and long work hours (Bean and Metzner 1985; Bozick 2007; Perna 2010). Still others focus on issues of inadequate financial aid (Perna and Li 2006; Schuh 2005; St. John et al. 2000; Wyner et al. 2007). All these factors are predictive of noncompletion in multivariate models.

However, there are two additional explanations for dropout and noncompletion that relate more directly to the summer bridge programs that are the focus of this article. One of these emphasizes inadequate academic preparation. Many students who enter college were not academically strong students during their high school years (Horn et al. 2001). One indicator of the lack of preparation is the fact that many students take remedial or developmental courses once they enter college, roughly 36% in recent cohorts (Achieve Inc. 2004; Aud et al. 2011). Remedial courses are often noncredit bearing, which slows progress toward a degree (Jaggars and Hodara 2011). Further, the nature of these courses may lead many students to become discouraged, as remediation by definition forces them to revisit subjects that were likely difficult for them in secondary school.

A second perspective, developed by Clifford Adelman (1999, 2006) and elaborated by others (Attewell et al. 2012), emphasizes the role of "academic momentum" in degree completion. In his analyses of longitudinal student data, Adelman found that, over and above a student's family background and high school preparation, a student's academic momentum during the first year of college, measured by numbers of courses taken each semester, and their trajectory over time, was predictive of final degree completion (cf. Complete College America 2011).

Summer bridge programs can be viewed both from the perspective of inadequate academic preparation for college and as an issue of academic momentum. From the former approach, many bridge programs are a kind of academic "boot camp," providing reviews of basic math, writing, or reading skills. Another focus of some bridge programs is study skills, planning, and other practical matters that entering students may underestimate or ignore, especially if they are first-generation college-goers. Indeed, even in those basic subject review courses, a latent benefit may be that students are exposed to these "soft skills" of college success. Thus, these programs are very much about making up for a lack of academic preparation in both senses of the term.

In addition, bridge programs may be important because of their impact on academic momentum. Students who enter community colleges and less selective 4-year colleges are often required to take a battery of skills or placement tests to assess their preparation in math, reading, writing, and so on. Until a student passes those remedial courses, she or he may not be allowed to proceed into credit-bearing, college-level courses (Jaggars and Hodara 2011). Therefore, remedial coursework tends to reduce a student's academic momentum toward the degree, understood in Adelman's (1999, 2006) sense.

At some colleges, bridge programs provide a way of quickly resolving skill deficits without losing academic momentum. Students who take this type of summer program are given intensive instruction, after which they are allowed to retake the skills or placement tests. If they pass those tests, students can begin their first semester of college by enrolling in regular credit-bearing courses. By succeeding in a bridge program, therefore, they have avoided detouring into a sequence of noncredit remedial or developmental courses—courses that often lead to dropping out—and are immediately moving toward a degree (Jaggars and Hodara 2011).

We thus see bridge programs as a potential convergence point between those who understand completion as a function of academic preparedness and others who posit momentum as the driving factor. These programs may both resolve early skill deficits and provide an initial boost to a student's pace in school.

Existing Evaluations of Bridge Programs

Several studies have evaluated summer bridge programs at single institutions. Buck (1985) reported that a summer bridge program at one 4-year college was associated with better retention. However, Gutierrez (2008) found no significant differences between bridge participants and controls at the University of New Mexico. Maples (2002) found significant results on retention into the second year at the University of Nevada but not longer-term effects

on graduation or retention. These studies were not methodologically sophisticated or statistically powerful; they had small sample sizes, they did not address selection bias, and some lacked adequate statistical controls for students' academic background.

Wathington et al. (2011) and Barnett et al. (2012) reported on a methodologically superior random assignment trial study of summer bridge programs in Texas. Six of the seven sites were community colleges, and program participants were tracked for 2 years. The bridge programs emphasized accelerated instruction in developmental math and reading. The program had no significant influence on retention or credit accumulation, except that in the year immediately following the intervention, participants were more likely to complete a college-level math or writing course than controls. After 2 years, however, there were no significant differences in total credits earned or in pass rates in first college-level math, writing, or reading courses, although the bridge participants had taken significantly fewer remedial credits than the controls. Overall, this study documented some immediate gains but no enduring advantages of program participation. The study did not follow participants until graduation, so that outcome was not examined.

In sum, prior research is mixed regarding the efficacy of bridge programs. Existing studies have focused on short-term outcomes and, with the exception of the single randomized controlled trial, have not been able to address potential differences in student characteristics. Further, there is no evidence of whether participation in a bridge program leads to higher chances of graduation, which is perhaps the most important potential benefit. This article attempts to address both of these weaknesses simultaneously. In the first of the analyses we report below, the students were tracked for a longer period of time, and data are available on graduation outcomes. In both sets of analyses, we use data that allow for ample control for student characteristics and also use propensity score matching to address selection bias. Our theoretical framework allows us to examine our findings about the efficacy of these programs from the perspectives of student preparation and of academic momentum.

Data and Method

National Data

The National Center for Education Statistics (NCES) directed a longitudinal survey that assembled a nationally representative sample of college freshmen and tracked them for 6 years, from 2004 until 2009. This study is known as the Beginning Post-Secondary Student Longitudinal Survey (BPS). In a sup-

plement to this study, NCES's survey staff requested transcripts from all the colleges and universities that each participating student attended during the 6-year period and coded enrollment information, courses taken, and grades and degrees received (Wine et al. 2011). These coded transcript files were recently made available via a restricted data license and provide the data for this article.

Our BPS sample is limited to persons in degree programs who had complete transcripts and who attended a college that, according to NCES's measures, was either a community college or a 4-year institution with low selectivity or open admissions. (Academically selective colleges and for-profit colleges are therefore excluded from our analyses.) NCES had also imputed values for missing data, using "hot deck" methodology, in which missing or unknown data points are replaced using values from similar cases; similarity is determined on the basis of nonmissing or known information about both "donor" and "recipient." The final imputed values are the average of multiple iterations of the imputation process. The BPS survey has a complex, two-stage sampling frame, which we accounted for by using the bootstrap-replicate survey weights provided by the NCES in all of our analysis (Wine et al. 2011).

Our central independent variable or "treatment" is whether a student enrolled in a bridge program during the summer prior to starting at college. Using the transcript data, we were able to distinguish between bridge programs and more general orientations for freshmen, both by examining the transcript dates—bridge programs typically last 4–6 weeks—and by the fact that bridge programs appear on student transcripts as actual courses taken with grades, even if these do not bear credit toward the degree. We constructed a dummy variable, with a value of 1 if a student attended a summer bridge and 0 otherwise.

The dependent or outcome variables describe a set of milestones of academic progress while in college: whether a student reenrolled for the second semester of their freshman year, whether the student enrolled in the fall semester of the second year of college, and so on. An additional outcome measured whether a student ever "stopped out" (failed to enroll) at any time during the 6 years. Finally, a variable indicated whether the student graduated with a degree (either an associate's or a bachelor's degree) during that 6-year span of the survey. Because the BPS data follow students through transfer, a degree can be completed at any institution. All these dependent variables were dichotomous dummy variables.

We report conventional logistic regressions in which the "bridge treatment" variable predicts one of these milestone outcomes, after adding statistical controls for each student's sociodemographic and academic background. These controls included the following: student's race/ethnicity, gender, age, nativity, citizenship, student's marital status, having a dependent child or family mem-

ber, whether the student's native language is English, household size, mother's and father's educational level, income, home ownership, and investments. There were also measures of each student's academic preparation and performance: high school GPA, SAT quartile, highest level of mathematics taken in high school, whether the student earned any college credits while in high school, and whether the student lacked a regular high school diploma. Additional control variables measured college characteristics: total enrollment, percentage of students who received federal grant and loan aid, tuition quartile, and percentage of black and Latino students at the institution.

Regression models have a serious methodological drawback: they are susceptible to selection bias. When there are sociodemographic or other differences between students who do enroll in a bridge program and those who do not, the estimates or regression coefficients in conventional models will become biased. While the coefficients do reflect the effect of the treatment on the dependent variable, they also incorporate any differences in background characteristics between treated and nontreated students (Morgan and Winship 2007). We address this issue of selection bias through an approach known as the counterfactual model of causal inference, using a statistical technique known as propensity score matching (Guo and Fraser 2010; Morgan and Winship 2007; Reynolds and DesJardins 2009).

Propensity score matching proceeds in three stages. First, a logistic or probit model is run to predict who undertakes the "treatment"—in our case, who attends a summer bridge program. This "treatment model" or "propensity score model" contains all available variables including students' demographic background and their high school academic characteristics. The dependent variable is a dummy variable, with a value of 1 for attending the bridge program (the treatment) and 0 otherwise. Interaction terms are included in the treatment or propensity model. According to Shadish et al. (2002, 162), including predictors that are multicollinear and predictors that are not statistically significant is not problematic for this stage of analysis, since the goal is to determine the predicted probability of treatment, rather than the coefficients of individual predictors.

From the logistic model, one calculates for each student the probability of taking a bridge program, given their values on all covariates in the model, a quantity known as the propensity score. The second step involves matching persons who did attend with persons with almost identical propensity scores who did not attend a bridge program. This was accomplished through a STATA program called psmatch2 that undertakes a form of matching known as nearest-neighbor matching with a caliper (Leuven and Sianesi 2003). In this instance, each treated case is matched with three untreated cases whose propensity scores are numerically very close to the treated case's score; the conventional distance or caliper we used is within one-quarter of a standard

deviation of the treated case's propensity score (Guo and Fraser 2010, 147). The end result is a treatment group and a control group, containing persons matched on the propensity score for treatment.

In experimental studies, random assignment of cases into treatment and control groups ensures that the two groups are balanced in terms of observed and unobserved background characteristics. In a parallel fashion, successful matching on propensity for treatment in a nonexperimental study should result in two groups that are closely balanced on all observed characteristics (though not necessarily on unobserved attributes). Consequently, it is important to ascertain whether matching did in fact result in balance on covariates (Morgan and Harding 2006). The appendix to this article, available online, provides several statistics assessing the degree of balance.

The third step of a propensity score matched analysis determines the magnitude of treatment effects and their statistical significance. This is accomplished in the psmatch2 program by calculating a *t*-test between the treated and untreated groups and reporting estimates for the average effect of treatment on the treated (ATT).

Community College System Data

The national BPS data do not provide information on why students entered bridge programs. In many community colleges and in some 4-year public colleges, the skills of students are tested at entry, using placement tests such as COMPASS or ACUPLACER. Our second data source consists of student tracking data obtained from six community colleges that are part of a single institution. These colleges offer an immersion-type summer bridge program for those students who score below a certain level on placement or skills tests in mathematics, writing, or reading. In these colleges, all students who "fail" one or more of those tests are required to take remedial coursework in those subjects. Completion of these remedial courses is a prerequisite for many introductory and required courses.

The optional summer bridge program offered in this system is a way of addressing the need for remediation prior to the beginning of the regular school year. The bridge program provides an intensive 4–6-week immersion that teaches arithmetic or algebra or reading or writing. At the end of the program, participating students are allowed to retake the placement test. If they pass the exam on this second occasion, then they do not have to take further remedial courses in that subject and can begin their first semester of college by enrolling in regular credit-bearing courses. However, not all students who perform poorly on the placement tests choose to enroll in the summer immersion program. Those who bypass the bridge program will be required

to enroll in and pass remedial or developmental courses, but they can do so at a later date, during their first year or two in college.

We analyzed administrative and student tracking data that followed a cohort of over 10,000 first-time freshmen in degree programs who entered these community colleges in the fall semester of 2010. This data set therefore allows us to focus on a particular type of summer bridge program—one that we believe is fairly common nationally—but which is not distinguishable within the national BPS data set.

For this second part of our article, we limit our sample to incoming freshmen who have failed a placement test and therefore are eligible to attend a summer bridge immersion program. Our analyses focus on whether or not, among students who failed a placement test, those who took a summer bridge program had better academic progress thereafter, compared to otherwise similar low-skill students who did not take the bridge program. We used identical propensity-matching methods as discussed above in order to minimize selection bias. The variables for matching included student's gender, race, age, dependency status, and nativity, whether English was a second language, cumulative high school academic average, and financial aid eligibility.

Findings

The National Sample

Table 1 reports descriptive statistics for the national BPS transcript sample. The data provide figures in two columns. The students in our analysis are those who attended a two-year or community college, or an open-admissions/less selective 4-year college, as defined by NCES. Only 7.4% of undergraduates in these relatively unselective colleges attend a bridge program in the summer months prior to beginning college.

Table 2 presents a logistic regression model predicting who attended a bridge program among the entire sample—some 5,600 undergraduates. In the model containing only demographic controls, nothing emerges as statistically significant. Once controls for academic preparation are added, the odds of attending a bridge program for Asian students are more than double the odds for white students. Older students are significantly more likely to attend bridge programs. Other demographic variables, such as gender, income, parents' education, being foreign-born, or not speaking English do not seem to be associated with taking a bridge program. Among the academic control variables, only having a high GPA during high school was associated with a far lower likelihood of attending a bridge program. In most respects, therefore, bridge programs seem to serve a very diverse set of entering students in this national sample.

TABLE 1

National BPS Sample: Descriptive Statistics (weighted)

	COMMUNITY COLLEGE OR LOW SELECTIVITY/OPEN ADMISSION	
	Mean	SD
Treatment:		
Attended bridge program (%)	7.39	.262
Demographic variables:		
Female	56.8	.495
Age (years)	22.4	8.02
Independent	31.3	.463
White	61.4	.487
Black	14.6	.353
Latino	14.8	.355
Asian	4.1	.197
Other	5.1	.222
Foreign-born	11.4	.316
Student is independent	31.3	.463
Student is married	12.8	.334
Has any dependents	19.9	.399
English is primary language	88.7	.317
Parental education variables:		
Parents' education is unknown/no degree	9.6	.295
Parents graduated high school	29.9	.458
Parents have less than BA	29.2	.455
Parents have BA or higher	31.1	.463
SES variables:		
Parents/student own a home	70.2	.457
Parent/student has significant investments	18.5	.388
Household income (log)	10.2	1.97
Academic variables:		
SAT score:		
No SAT score	42.3	.494
1st quartile	13.1	.338
2nd quartile	12.7	.333
3rd quartile	15.4	.360
4th quartile	16.3	.369
Math preparation:		
Unknown	22.6	.418
Less than algebra	17.2	.377
Algebra 2	42.3	.494
Precalculus	11.9	.324
Calculus	5.9	.237
High school GPA:		
.5–1.9	3.9	.194
2.0–2.9	25.9	.438

TABLE 1 (*Continued*)

	COMMUNITY COLLEGE OR LOW SELECTIVITY/OPEN ADMISSION	
	Mean	SD
3.0–4.0	25.2	.435
3.5–4.0	15.0	.357
No GPA info	29.8	.457
N	5,580	

Table 3 examines the relationship between attending a bridge program and academic outcomes. Given the high degree of attrition from college, we looked at several milestones over the course of a student's career. The first milestone, or dependent variable, was whether a student reenrolled for the second semester of their freshman year (i.e., spring of their first year). Second, we asked whether students remained enrolled in the fall of the second year of college. Third, we examined whether they ever "stopped out" (failed to enroll) at any time during the 6-year span of the research. Fourth, and most important, we determined whether the student graduated with a degree (either an associate's or a bachelor's degree) during that 6-year span.

Table 3 summarizes analyses that included the many covariates that serve as controls (control variables listed in "Data and Method"). The full regression models are included as an appendix to this article (table A1; tables A1–A3 available online). The left-hand columns of table 3 report conventional logistic regression models. For ease of interpretation, we translated the results so they report the percent of students who attended a bridge program who reached the given milestone, and we compare this to the percent of students who did not attend a bridge program but also reached that milestone. Those percentages are adjusted for the control variables listed. Significance tests are provided that test whether the difference between bridge and nonbridge students is significantly different from 0. We see that significantly more (11.0 percentage points) bridge students enrolled in the second year, and significantly more (9.3 percentage points) graduated within 6 years, compared to otherwise similar nonbridge students.

The right-hand column of table 3 reports equivalent percentages and significance levels, derived from propensity-matched models that minimize selection bias. The controls or covariates were the same as in the left column models. These propensity models should provide more accurate estimates of the effects of bridge than the conventional regressions. They indicate a 5.29-percentage-point advantage in retention into the second year, but this advantage is not statistically significant. Consistent with the logistic regression findings, bridge

TABLE 2

Logistic Regression Predicting Attendance of a Summer Bridge Program for Students in Community Colleges and 4-Year Low-Selectivity or Open-Admissions Colleges

	Odds Ratios with Demographic Controls	Odds Ratios with Academic Preparation
Race (ref: white):		
Black	1.458	1.560
Latino	1.812	1.855
Asian	2.920	2.987
Other race	1.952	1.899
Female	1.486	1.563
Interaction terms:		
Black × female	.854	.813
Latino × female	.696	.680
Asian × female	.565	.579
Other × female	.572	.565
Age	1.016	1.030*
Household income (log)	1.085	1.082
Parent's highest education (ref: HS):		
Unknown	.955	.926
Less than a BA	1.073	1.069
BA or higher	1.170	1.206
US-born	.912	.894
Home ownership	.963	.926
Has any investments	.837	.822
Married	1.491	1.525
Has any dependents	.909	.978
English as primary language	1.643	1.640
Standardized test score (ref: 3rd quartile):		
No score		.541
1st quartile		1.137
2nd quartile		.922
4th quartile		1.034
High school GPA (ref: 3.0–3.4):		
No HS GPA info		.652
.5–1.9		1.130
2.0–2.9		1.047
3.5–4.0		.549*
High school math (ref: algebra 2):		
No HS math info		.990
Less than Algebra 2		1.696
Precalculus		.947
Calculus		1.685
Observations	5,580	

* $p < .05$.

TABLE 3

Summer Bridge Effects for 2-Year or Low-Selectivity/Open-Admissions 4-Year College Students

	REGRESSION MODEL			PROPENSITY MODEL		
Outcome	Bridge	No Bridge	Effect Size (%)	Bridge	No Bridge	Effect Size (%)
Reenrolled spring first year	89.49	89.43	.06	86.90	86.17	−.73
Reenrolled fall second year	80.33	69.35	10.98**	76.32	71.03	5.29
Ever stopped out	38.24	37.61	.63	39.27	36.81	2.46
Graduated in 6 years	39.56	30.25	9.31*	44.29	34.68	9.61**

NOTE.—Data are from National BPS transcripts. $N = 5{,}580$ for both models.
* $p < .05$.
** $p < .01$.

program students had a statistically significant 9.61-percentage-point higher rate of graduation than nonbridge students. In sum, bridge is associated with significantly better degree completion.

Having discovered that, on average, students who attended a bridge program fared better on some important outcomes than otherwise similar students who did not attend, we can test whether certain types of students benefit more or less from attending a bridge program than others. For this purpose, we limited the outcome variable to graduation with a degree within 6 years of entering college. Table 4 presents the results of heterogeneity testing. To estimate heterogeneous effects, we calculated propensity-matched models after splitting the sample on dimensions such as race (black and Hispanic vs. all others); gender (men vs. women); first-generation college students versus others; students with low high school GPAs versus others; and students with a high likelihood of attending a bridge versus those with a lower likelihood.

In table 4, we find that bridge attendees have significantly higher graduation rates across all racial groups, but the difference is higher among black and Hispanic students (12 percentage points). Both men and women who took bridge programs show about a 10 percentage point advantage in graduation rate, but that difference is only statistically significant among women. Both first-generation college-goers and students whose parents had gone to college have significantly higher graduation rates if they attend bridge than those who do not, but the first-generation group has a higher effect size. Bridge programs have a much larger (11.4 percentage points) and statistically significant impact

TABLE 4

Heterogeneity Tests among 2-Year or Low-Selectivity/Open-Admissions 4-Year College Students

	GRADUATED IN 6 YEARS (%)			
	Bridge	No Bridge	Effect Size	*N*
Race:				
White, Asian, or other race	46.43	38.29	6.81*	3,990
Black and Hispanic	38.68	26.10	12.58*	1,510
Gender:				
Male	43.51	33.33	10.18	2,300
Female	45.22	34.86	10.36**	3,250
Family background:				
First-generation college student	41.80	30.05	11.75*	2,100
Not a first-generation college student	46.41	36.29	10.13**	3,430
Academic preparation:				
High school GPA below 3.0	38.53	27.06	11.46*	1,730
High school GPA 3.0 or above	52.66	48.88	3.77	2,470
Propensity to take summer bridge:				
Low (below median)	51.11	42.04	9.07	2,640
High (above median)	42.16	32.96	9.20**	2,860

NOTE.—Data are from National BPS transcripts.

* $p < .05$.

** $p < .01$.

on graduation among those with lower high school grades. Finally, for the kinds of students who typically do attend bridge programs (i.e., those with a high propensity for attending), attending a bridge program has a significant effect on graduation. Students whose characteristics make them less likely to attend a bridge program do not have a significantly higher graduation rate, even when they do, in fact, attend a bridge program, although the magnitudes are similar.

With that one exception, our analyses provide a consistent pattern. *Ceteris paribus*—all other things being equal—students who attend bridge programs between high school and their first regular term of college have higher graduation rates than students who do not enroll in a bridge program. In general, those who attend a bridge program have higher graduation rates, but black and Hispanic students, women, and less academically prepared students appear to experience even more of a graduation effect than others. Moreover,

the kinds of students who typically attend such programs benefit more than those whose academic and demographic profile is atypical but who attend a bridge program anyway.

In sum, in this national data set, enrolling in a bridge program is associated with higher graduation rates. The magnitude of effects is fairly large—around a 10-percentage-point graduation boost in nonselective colleges. The largest effects seemed to occur for black and Hispanic students, for first-generation college-goers, and for those with less academic preparation.

The Community College System

Propensity score analyses of the effects of summer bridge programs on students who attended six community colleges are presented in table 5. Recall that this second set of analyses are intended to delve deeper into the question of how bridge programs impact student outcomes in the short term. The first milestone considered is whether a student began their first year of college as a full-time or as a part-time student, the latter defined as fewer than 12 credits of coursework. There was a small but statistically significant difference (2.84 percentage points) in the proportion of bridge students who enrolled full-time for their first regular college semester, compared to matched controls.

The first panel of rows in table 5 considers retention from semester to semester. Bridge students were significantly more likely to enroll in the summer session after their first year, and more likely to enroll for the fall and spring semesters of their second year, compared to matched controls who did not attend the summer bridge program. All of these effects were statistically significant, and the enrollment gap between bridge and control students increased over time until the bridge participants had nearly a 5-percentage-point higher enrollment by the end of their second year in community college.

The next panel in table 5 report on credits attempted and the ratio of credits earned to credits attempted during the first 2 years of community college. These analyses are conditioned on students' enrollment in the semester in question. In these comparisons, there were statistically significant effects that grew from 4 to 6 percentage points over subsequent semesters, in which students who attended a bridge program passed a larger proportion of their courses than did controls.

Bridge students also took fewer remedial credits in the first 2 years than controls; the effect was small (about one and a half fewer credits of remedial classes) but statistically significant. In terms of cumulative outcomes in the first 2 years, table 5 reports that students who took bridge programs had attempted (3.02 credits), earned (3.49 credits), and passed a larger proportion

TABLE 5

Bridge Programs at Six Community Colleges. Propensity Score Match Models Comparing Remedial Students Who Did and Did Not Attend a Bridge Program

Outcome	Treatment (Took Bridge; %)	Control (No Bridge; %)	Treatment Effect (Percentage Points)	*p*
Enrollment status:				
Fall 2010 attended full-time	92.69	89.85	2.84	.000***
Spring 2011 enrolled	84.42	84.36	.05	.958 NS
Summer 2011 enrolled	11.80	9.56	2.24	.016*
Fall 2011 enrolled	68.45	63.94	4.50	.001**
Spring 2012 enrolled	61.15	56.35	4.80	.001**
Earned/attempted ratio:				
Fall 2010	63.85	59.78	4.07	.000**
Spring 2011[a]	64.76	59.36	5.39	.000***
Fall 2011[a]	69.57	63.54	6.02	.000***
Number of nonremedial credits attempted:				
Fall 2010	9.86	8.47	1.39	.000***
Fall 2011[a]	12.59	11.52	1.07	.000***
Cumulative GPA:				
Fall 2010	2.23	2.06	.17	.000***
Spring 2011[a]	2.08	1.92	.16	.000***
Fall 2011[a]	2.06	1.90	.15	.000***
Cumulative credits earned by fall 2011	24.90	21.41	3.49	.000***
Cumulative credits earned/attempted ratio by fall 2011	60.81	55.41	5.39	.000***
Cumulative credits attempted by spring 2012	43.89	40.87	3.02	.000***

NOTE.—$N = 10{,}610$; source of authors' analyses: administrative data for six community colleges in one state system.

[a] Conditional on enrollment.

* $p < .05$.

** $p < .01$.

*** $p < .001$.

(5.4 percentage points) of their credits than similar students who had not. All these differences were statistically significant.

These analyses of a cohort of incoming students provide a different perspective than the earlier national data. The national data did not measure whether students had failed skills tests and were therefore required to take remedial/developmental education, but the cohort data from this university system did include this information. Among this subset of remedial students, the cohort data show that those undergraduates who undertook a summer bridge program subsequently made significantly better progress toward a degree, whether measured as retention, numbers of credits attempted, proportion of courses passed, or accumulated credits. In sum, remedial students who enrolled in the community college system's summer bridge program gained a significant advantage in academic momentum during their first 2 years of college compared to otherwise similar remedial students who did not attend that program.

Conclusion and Discussion

Limitations and Future Research

Though our results suggest a strong positive impact of bridge programs on degree completion and on retention, we feel the need to qualify our findings based on other research. One study found a null result using a random assignment design (a randomized controlled trial), which is normally considered a strong test of program efficacy. However, that study had a relatively small sample of students attending several colleges in Texas and tracked these students for 2 years only (Barnett et al. 2012; Wathington et al. 2011). It did not last long enough to measure who graduated. Further, as we will discuss below, bridge program efficacy may be determined by other aspects of institutional policy.

The discrepancy between our longer-term results using national data and the randomized controlled trial study in Texas suggests that some caution is warranted in interpreting our findings. However, because bridge programs are already a well-established feature in higher education, we recommend that more colleges engage in formal evaluation of their programs of the kind we undertook, using administrative data for a cohort of community college students, so that a larger body of evidence accumulates to guide policy in this area. Qualitative research with students who participate in bridge programs would provide insights into the lived experiences that condition the efficacy of this type of program.

Policy Implications

Our findings using transcript data for a nationally representative sample of undergraduates at community colleges and less selective 4-year colleges indicate that bridge programs between high school and college have statistically significant positive effects on degree completion among otherwise similar students. Moreover, our findings indicate that the effect size of such bridge programs is substantial: a 10-percentage-point improvement in degree completion is large enough to suggest that whatever their intended purpose, bridge programs may be a valuable tool in bolstering college completion rates. In addition, bridge programs seem to work best for those students who are at higher risk of not completing a degree.

One policy implication that would follow from these findings is that nonselective colleges could improve their graduation rates if they increased the proportion of entering undergraduates attending summer bridge programs. We hesitate to recommend this, however, because of the mixed findings of other studies that previously studied this issue. A second policy implication concerns state education policy makers. Since many nonselective and open-admissions colleges receive federal and state funding for programs like summer bridge, our findings suggest that these programs are important and should be cultivated, especially in terms of recruiting students who need them the most.

Discussion: Bridge Programs in Context

We can speculate about one factor that may lie behind the inconsistency of prior findings across studies of summer bridge: the efficacy of bridge programs may depend not only on the quality of instruction or the content of the bridge courses and pedagogy but also on the structure of placement testing and remedial coursework at a college, and how this is related to bridge programs.

For example, some community colleges and 4-year colleges require skills testing for all applicants for admission. Depending on how well a student performs on those tests, the student may be routed directly into college-level courses, or (if the student fails a test) she or he may be routed into a sequence of non-credit-bearing developmental or remedial courses, courses that must be passed before the student can move into regular college courses.

A body of research has accumulated that suggests that only a small proportion of students who enter a remedial sequence ever complete it satisfactorily or pass the next college-level course (Jaggars and Hodara 2011). A large majority of students who enter the remedial sequence either fail or withdraw from courses, or they drop out of college. This problem seems to be especially common in remedial math. One study of this phenomenon titles itself "Re-

mediation: Higher Education's Bridge to Nowhere" (Complete College America 2012). However, not all colleges follow this pattern of testing plus remedial course sequences; one might describe colleges or universities that do as "high-stakes-test" colleges. This term is not to be confused with those institutions that require high scores on college entrance exams such as the SAT. Here, we mean institutions that administer tests to incoming students—tests that place some students into time-consuming and potentially discouraging remedial course sequences. In contrast, other institutions may simply not engage in placement testing at all or may do so without the possibility of remedial courses that can obstruct the path toward degree completion.

At high-stakes-test colleges, summer bridge programs can fulfill a special function: if a student fails one of the initial placement or skills tests, that student has the option of attending a summer bridge program that offers intensive or accelerated instruction in that skill area (most frequently in math). At the end of the summer bridge, participating students are allowed to retake the skills test, and if they pass it the second time around, they are admitted directly into regular courses. They do not need to take remedial coursework. In other words, in some colleges, summer bridge programs enable some students to avoid taking remedial sequences. Because those sequences are associated with very high dropout rates, succeeding in a summer bridge, in effect, makes it less likely that a student will drop out and more likely that they will graduate. This was the pattern we observed in the six-campus system of community colleges that we analyzed in this article.

Given this framework, we can see how both academic momentum and student preparedness converge as potential explanations for student dropout and noncompletion, and how bridge programs provide a potential remedy to both problems. The broader use of bridge programs would allow schools to continue to encourage better academic preparation while avoiding the potentially damaging effects to academic momentum wrought by remedial sequences. But, given that not all institutions have such assessments and the attendant mandatory remedial sequences, this does not explain every situation.

In sum, we would expect that at high-stakes-test colleges, summer bridge programs will be associated with higher graduation rates, while at colleges that are not high stakes, the effects of summer bridge programs on student progress might be more muted and in some cases nonsignificant. Hence a bridge program may only have these effects if there is a proverbial troll lurking beneath the bridge; in these institutions, academic preparation (and high-stakes testing of students' academic preparation) is intertwined with momentum. This is a hypothesis at this point, because the national data that we analyzed in this article did not measure whether a college is or is not a high-stakes-testing college, so we cannot test our hypothesis. However, the cohort sample was from a high-stakes-testing institution, and there we found signif-

icant differences between bridge and nonbridge students. If correct, our hypothesis would suggest that the average 10-percentage-point advantage in graduation rates that we found across unselective colleges nationwide might be a low estimate, since it averages together outcomes in high-stakes and non-high-stakes colleges.

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