Abstract Title Page
Not included in page count.

Title: A Preliminary Assessment of the Cost and Benefit of the North Carolina's Early College High School Model and its impact on Postsecondary Enrollment and Earned College Credit

Authors and Affiliations:
Fatih Unlu, Abt Associates
Julie Edmunds, University of North Carolina - Greensboro
Lily Fesler, Abt Associates
Beth Glennie, RTI International

Abstract Body

Background / Context: The changing nature of the U.S. economy has fostered concerns that too few students are successfully completing postsecondary education (Achieve, 2004). Three quarters of those who enter high school graduate within four years, with approximately 70 percent of those graduates enrolling immediately in some form of postsecondary education (Ross et al., 2012). Of those who do attend, insufficient numbers complete a degree with only a little less than half (49 %) of beginning postsecondary students attaining some sort of a postsecondary credential within six years of enrolling (Ross, et al., 2012). As a result, there have been numerous initiatives to increase the number of students who graduate from high school prepared to enroll and progress in postsecondary education. One approach is the Early College High School (ECHS or early college) model, small schools that blur the line between high school and college. The primary goal of the early college model is to increase the number of students who graduate from high school and who continue on to and succeed in college.

Purpose / Objective / Research Question / Focus of Study: This paper presents results from a longitudinal experimental study that is examining the impact of early colleges on students' outcomes in high school and in postsecondary (PS) education, specifically on postsecondary enrollment and college credit accrual during and after high school. We also provide an interim assessment of the cost and benefit of the model.

Setting: The schools in this study are located in districts throughout the state of North Carolina. They include schools located in rural and urban settings from all regions of the state.

Population / Participants / Subjects: The sample for this paper includes 716 students who applied to six different early colleges[1] and enrolled in 9th grade in the 2005-2006, 2006-2007, and 2007-2008 school years. These six schools enrolled a total of eight cohorts of students (two schools enrolled two different cohorts). Table 1 shows descriptive statistics for this sample.

Intervention / Program / Practice: The ECHS model is an innovative approach to preparing students for college. It represents a comprehensive school reform model that is focused explicitly and purposefully on preparing all of its students for college (Edmunds, 2012). Early colleges provide students with concurrent high school and college experiences, in some sense eliminating the transition between these two stages of education. Primarily located on the campuses of two- or four- year colleges and universities, early colleges are expected to provide an academically rigorous course of study with the goal of ensuring that all students graduate with a high school diploma and two years of university transfer credit or an associate's degree. Some schools are structured as 4-year schools and some schools are structured to have students complete the curriculum in 5 years. Each early college is also expected to implement and exhibit a specific set of principles, known as Design Principles, developed by North Carolina New Schools (NCNS—the public-private partnership that manages these schools) that represent characteristics of high quality high schools. These Design Principles, as articulated by NCNS, are as follows: (1) Ensuring that students are ready for college; (2) Instilling powerful teaching and learning in schools; (3) Providing high student/staff personalization; (4) Redefining professionalism; (5) Leadership and (6) Implementing a purposeful design (North Carolina New Schools Project, 2011). Figure 1 provides a conceptual model of the these components.

Research Design: The study uses a longitudinal experimental design in which participating early

[1] A total of 19 schools enrolled in the study over time. These six represent the first schools enrolled in the study and the only schools whose students have progressed through the beginning of six years after 9th grade with the necessary data available for the analyses presented in this paper.

colleges had to have more applicants than available slots and had to agree to use a lottery to randomly assign students. In each of the school's lotteries, each student applying to the early college was assigned a random number and the list of students was ordered from lowest to highest, with the lowest numbers being selected into the early college until all available slots were filled. Applicants who were offered enrollment into an ECHS make up the treatment group while the rest of the applications who enrolled somewhere else make up the control group.

Data Collection and Analysis:

Data Sources. The data used in this paper come from administrative data collected from four primary sources: the North Carolina Department of Public Instruction (NCPDI), the National Student Clearinghouse (Clearinghouse), the North Carolina Community College System (Community College), and the Integrated Postsecondary Education Data System (IPEDS). The NCDPI collects data from all schools in North Carolina, including demographic data, test scores, behavioral data, transcript data, dropout data, graduation data, and school-level expenditures. The Clearinghouse collects data representing approximately 94 percent of students enrolled in postsecondary institutions in the United States. The primary data available include enrollment by semester, institution in which a student is enrolled, and type and date of degrees received. The Community College data includes information about each course taken, how many credit hours were attempted, how many credit hours were earned, and whether the course was developmental or remedial. Finally, we linked the IPEDS finance data to the NSC data to determine the costs of the postsecondary institutions the students in our study were attending.

Measures. This paper examines the ECHS impact on two primary outcomes on which the interim assessment of the cost-effectiveness of the model is based on. The first outcome is concerned with enrollment in postsecondary education and captured by two distinct variables: (1) a cross-sectional dichotomous measure that pertains to enrollment in a two-year PS institution in a given grade of high school and is created using the Community College data and (2) a cross-sectional categorical measure created using NSC data that captures whether a student was (i) enrolled in a two-year postsecondary institution, (ii) enrolled in a four-year postsecondary institution, or (iii) was not enrolled in any postsecondary institutions in each post-high school year.

The second outcome – cumulative college credits earned during and after high school – is also captured by two variables: The first variable records the cumulative number of credits a student has earned from a two-year institution, expressed in full-time equivalents (FTEs) or number of years of college credits earned during high school. The second variable is holds credits earned from a four-year institution, expressed in FTEs over the same time frame. This variable is created using the NSC data.

Comparing costs incurred by students over the course of their postsecondary education may not be a fair comparison since early college students do not pay for college courses they have taken in high school while traditional students do. Therefore we have opted to conducting the cost-benefit analysis from the society's perspective by examining the effect of ECHS model on overall educational spending (not educational spending by any one individual) and societal benefits associated with educational attainment. Another important feature of our cost-benefit analysis is that we calculate a cost and benefit figure for each student a function of their education history and baseline characteristics and use these student-level figures for treatment and control students to estimate the effect of ECHS on the average societal cost and benefits of educational attainment and use the model's effect on the net benefits (benefit minus cost) to assess its cost-effectiveness. This analysis is described in more detail below.

In order to calculate educational costs as accurately as possible for each student, we determine high schools and two- and four-year colleges he/she attended, the cost of these institutions, and the amount of time he/she spent in each institution. The total cost for him/her is the sum of his/her high school cost, the cost of community college courses he/she took while in high school, and the cost of the two-or four-year institutions he/she attended post high school. Figure 2a shows the details of this calculation.

Societal benefit figures for each student are based on Carroll and Erkut (2009)'s societal benefit estimates provided separately for five educational attainment categories: (1) high school dropout (no college); (2) high school dropout (some college); (3) high school graduate (no college); (4) high school graduate (some college); and (5) 4-year college graduate. The placement of students into the first three categories uses the actual data we have on whether they've graduated from high school, whether they've taken any college credits, and whether they've graduated from college. Unfortunately we do not have sufficient data to place students into the last two categories deterministically so this is based on a prediction analysis. Specifically, students who are marked as having graduated from high school (according to the NCDPI data), have taken some college credits while in high school and/or after high school (according to the Clearinghouse and Community College data), but are not predicted to graduate from college (which is explained below) are placed in the fourth group.

The fifth group includes students who are marked as having graduated from high school (according to the NCDPI data), have taken some four-year college credits after high school (according to the Clearinghouse), and either have graduated from a four-year institution (according to the Clearinghouse), or are predicted to graduate from a four-year institution. All students who were enrolled in a four-year institution after graduating from high school were eligible to graduate from college. According to the National Center for Education Statistics, 58% of students complete a four-year degree within six years after enrolling in a four-year institution. Slightly fewer than 58 percent of control students who enrolled in a four-year institution after college have at least two FTEs at the end of their fourth year after college, so we determined two FTEs to be the threshold amount of FTEs a student would need by the end of four years post high school in order to graduate from college within six years. We applied this threshold to both treatment and control students, so students are predicted to graduate from a four-year institution if they are enrolled in a four-year university after high school and have at least two cumulative FTEs four years post high school. Figure 2b shows the details of the benefits calculation.

Statistical Analyses. We conduct two sets of statistical analyses. The first set are tailored to predict students' cumulative college credits accrued by four years post high school while the second set estimate the impact of the early college model on postsecondary outcomes and costs and benefits associated with educational attainment.

We use three separate regression models in the prediction process. The first model uses all students with available cumulative FTEs at one and two years post high school (FTEs at PHS1 and FTEs at PHS2, respectively) and specifies FTEs at PHS2 as a linear function of FTEs at PSH1 and student-level baseline covariates including demographics and academic achievement in the 8^{th} grade. The second model uses all students with actual FTEs at PHS2 and PHS3 and specifies FTEs at PHS3 as a function of FTEs at PHS2 and student covariates. Finally, the third model specifies FTEs at PSH4 as a function of FTEs at PHS3 and covariates and is estimated using all students with actual accumulated credit measures at PHS3 and PHS4. These models are then used to predict all students' accrued credit at PHS4 (which is then used to calculate the cost and benefits as described above). Figure 3 shows data availability and prediction patterns.

The impacts of early colleges on the postsecondary outcomes and cost and benefits are estimated within an Intent-To-Treat (ITT) framework, in which a student's initial experimental status as a treatment or control student serves as the treatment contrast. The impacts are estimated using multivariate linear regression models that include site indicators (or site fixed effects), interaction of the treatment indicator with the site indicators (which site level impact estimates that are then pooled to yield the overall impact estimate), and baseline student characteristics including demographic characteristics such as gender, race/ethnicity, age, free/reduced price lunch status, and 8th grade academic performance.

Findings / Results: Figures 4 through 7 shows the impacts of the model on the four outcome variables described above. Specifically, Figure 4 shows that the early colleges have a large and statistically significant impact on enrollment in two-year PS institutions while still in high school. Figure 5 suggests in the first three years post high school, the four-year enrollment rate in the treatment group was larger than the control group (e.g., 39% vs. 27% at PHS2 which was the only statistically significant difference) while the two-year enrollment rate in the control group was larger than the treatment group (e.g., 41% vs. 19% at PHS1). Figure 6 shows that treatment students, on average, accumulated substantially (and statistically significantly) larger number of two-year college credits during high school. Figure 7 suggests that credits obtained from two-year programs and total college credits were significantly higher for treatment students than control students in each year after high school.

Figure 8 shows that relatively fewer students with similar proportions across the treatment and groups are allocated to the first three educational attainment categories. While half of the control students were allocated to the fourth group, a noticeably lower proportion of treatment students (33 percent) were placed in this group. Finally, there was a considerable difference between the proportion of treatment and control students who are placed into the fifth group (four-year college graduates): 61 percent of treatment vs. 40 percent of control.

Figure 9 provides the graphical comparison of societal costs and benefits of educational attainment of treatment and control students and also demonstrates the net benefits of the early college model. The first two bars in this figure suggest that both the societal costs and benefits associated with educational attainment were statistically significantly larger for treatment students than control students (treatment cost=$66K, control cost=$55K; treatment benefit=$265K, control benefit=$240K). The net benefit for the treatment group ($198K) was much larger than the net benefit for the control group ($185K), leading to an average treatment-control net benefit difference of $13K, which can be attributed to the early college model given the underlying experimental design. Remaining bars in the graph shows this information for various subgroups.

Conclusions: Early results from this study show that the Early College High School model is increasing students' enrollment in postsecondary education, primarily by the required exposure in high school. The results show that, as is inherent in its design, the program is successful in providing early access to college. This paper also reports results from a detailed cost and benefit analysis of the early college model. This analysis demonstrates that the model has a substantial impact on societal benefits associated higher educational attainment of early college students which offsets the higher costs of the model, yielding a positive impact on the expected net benefits to the society. It is important to note that the cost-benefit analysis relies on predicted college degree accrued and educational attainment for most students in the sample, which may decreased the accuracy of the reported estimates. We will update these results with one more year of data by the time of the Spring conference.

Appendices

Not included in page count.

Appendix A. References

Achieve. (2004). Ready or not? Creating a high school diploma that counts. Retrieved from www.achieve.org/dstore.nsf/lookup/ADPreport/$file/ADPreport.pdf

Caroll, S. H. and Erkut, E. (2009). The Benefits to Taxpayers from Increases in Students' Educational Attainment. Retrieved from http://www.rand.org/content/dam/rand/pubs/monographs/2009/RAND_MG686.pdf

Edmunds, J. A. (2012). Early Colleges: Redesigning high schools for college readiness. *New Directions for Higher Education, 158*(81-90).

North Carolina New Schools Project. (2011). Design Principles. Retrieved October 2, 2011, from http://newschoolsproject.org/our-strategy/design-principles

Ross, T., Kena, G., Rathbun, A., KewalRamani, A., Zhang, J., Kristapovich, P., et al. (2012). *Higher Education: Gaps in Access and Persistence Study*. Washington, DC: U.S. Department of Education, National Center for Education Statistics.

Appendix B. Tables and Figures

Figure 1: Early College Theory of Change Relative to College Readiness

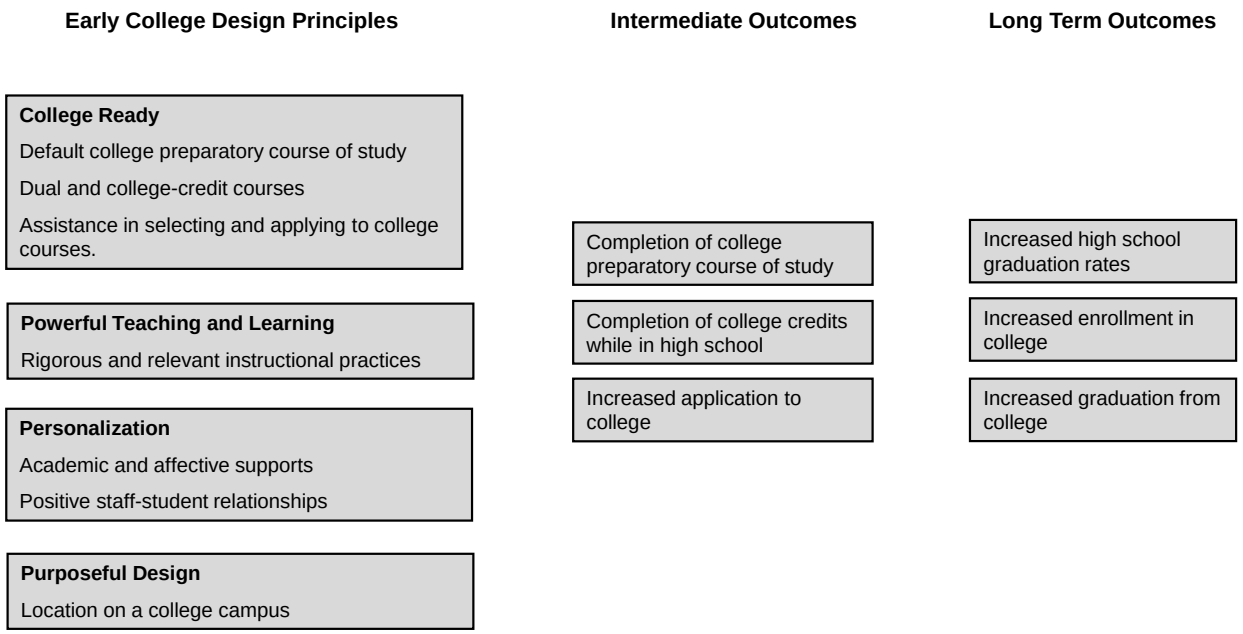


Figure 2a: Calculation of Costs

Cost Component	Source	Notes on Calculation
High School	NCDPI	Depends on HSs attended and time spent
Two-year courses taken in HS	NCCCS and IPEDS	Sum (2-year courses attempted in HS x Cost of CC)
Two-year courses taken post HS	NSC and IPEDS	Sum (estimated cumulative 2-year credits PHS* x Cost of CC)
Four-year courses taken post HS	NSC and IPEDS	Sum (estimated cumulative 4-year credits PHS* x Cost of 4-year college)
*For some students, PHS credit accumulation is predicted		

Figure 2b: Calculation of Benefits

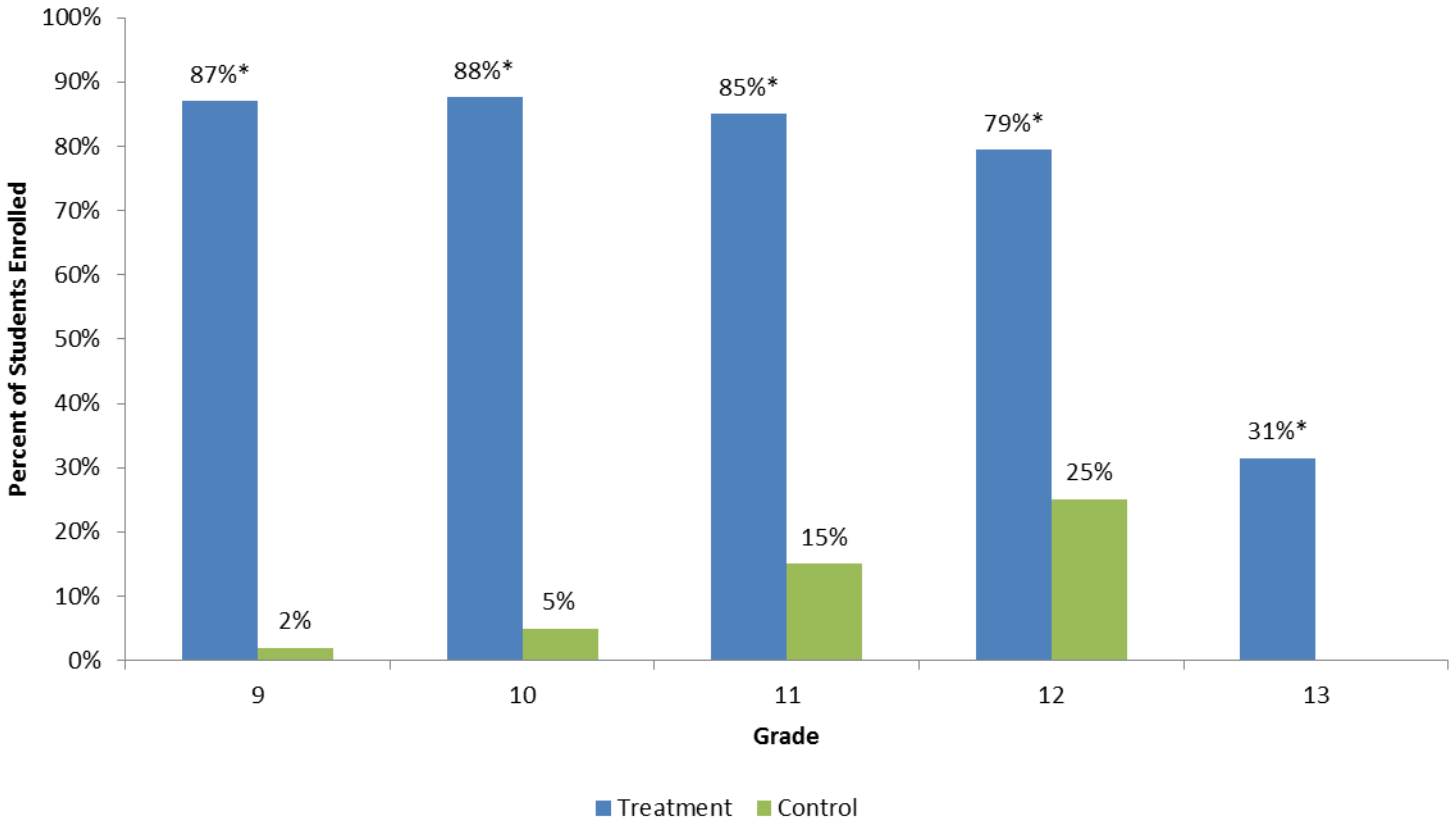
Educational Attainment	Determination of Status
High school dropout, no college	Marked as dropout and not found in NCCCS or NSC
High school dropout, some college	Marked as dropout and found in NCCCS and/or NSC. Not enough credits for a 4-year degree
High school graduate, no college	Marked as HS graduate but not found in NCCCS or NSC
High school graduate, some college	Marked as HS graduate and found in NCCCS and/or NSC. Not enrolled in a 4-year college and/or predicted college credits at PHS4 do not exceed the threshold
Bachelor's Degree (or more)	Marked as HS graduate and enrolled in a 4-year college. Actual/predicted college credits at PHS4 do exceed the threshold.

Figure 3: Availability of Data

Year	Cohort 1	Cohort 2		Cohort 3	
	4 year	4 year	5 year	4 year	5 year
2006	HS1				
2007	HS2	HS1	HS1		
2008	HS3	HS2	HS2	HS1	HS1
2009	HS4	HS3	HS3	HS2	HS2
2010	PHS 1	HS4	HS4	HS3	HS3
2011	PHS 2	PHS 1	HS5	HS4	HS4
2012	PHS 3	PHS 2	PHS 1	PHS 1	HS5
2013	PHS 4	PHS 3	PHS 2	PHS 2	PHS 1
2014		PHS 4	PHS 3	PHS 3	PHS 2
2015			PHS 4	PHS 4	PHS 3
2016					PHS 4
ECHS N	26	23	63	29	88
Control N	36	38	45	123	129

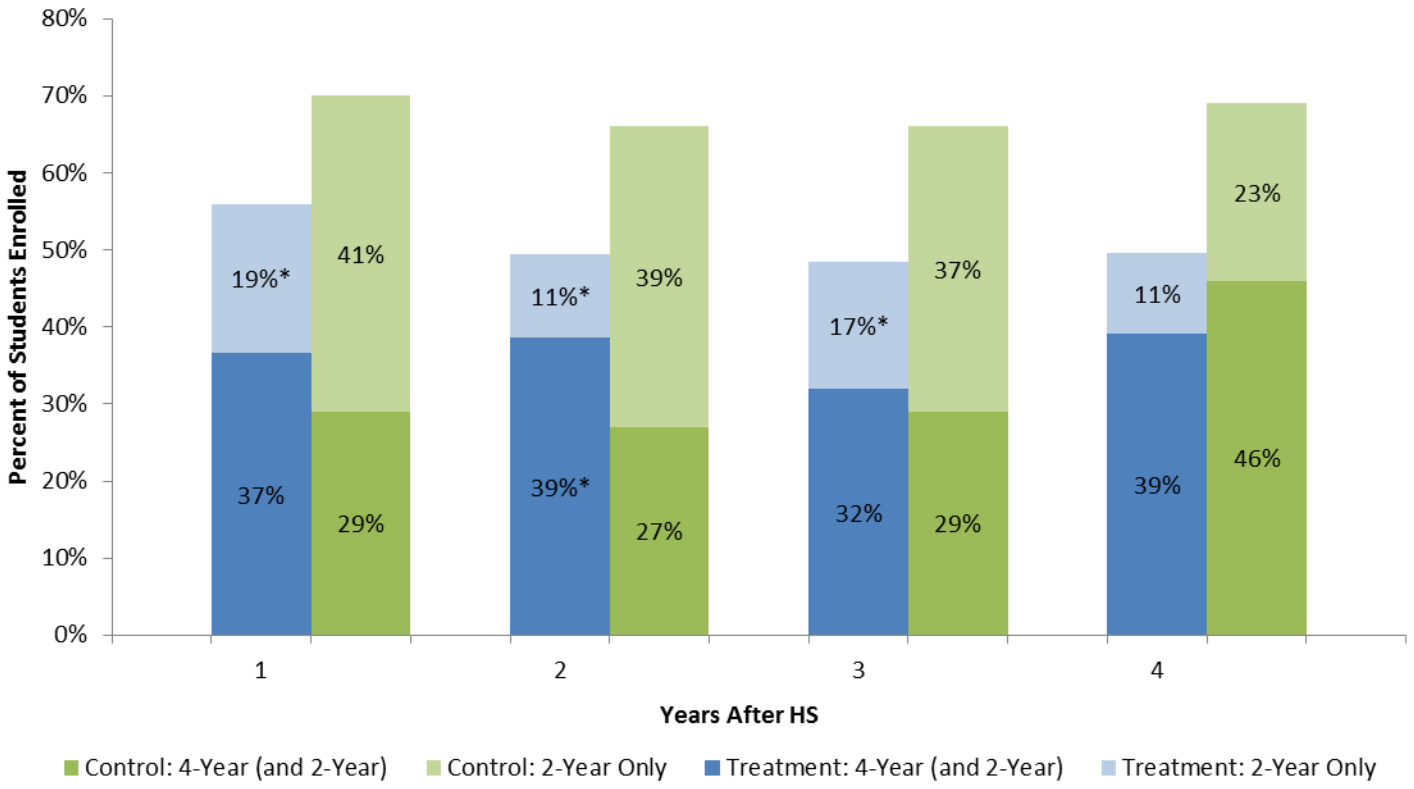
Known
Predicted
HS = High School
PHS = Post High School

Figure 4: Percentage of Students Enrolled in Two-Year College Courses in High School (Cross-Sectional)



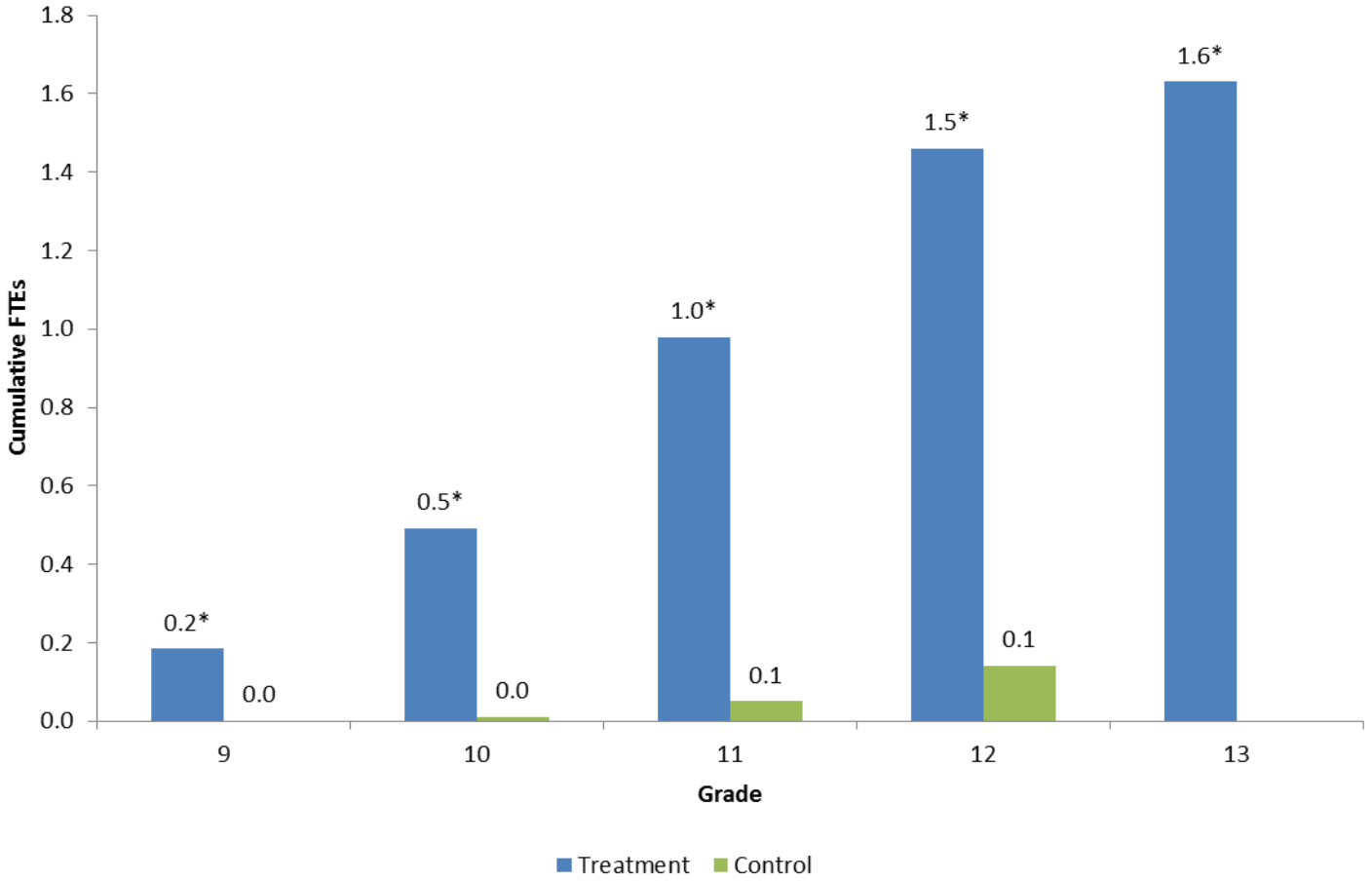
Control mean is the unadjusted group average and treatment mean is the control mean plus the impact estimate. Statistically significant treatment-control differences at the $p<0.05$ level are shown by *.

Figure 5: Percentage of Students Enrolled in Two and Four-Year College Courses After High School (Cross-Sectional)



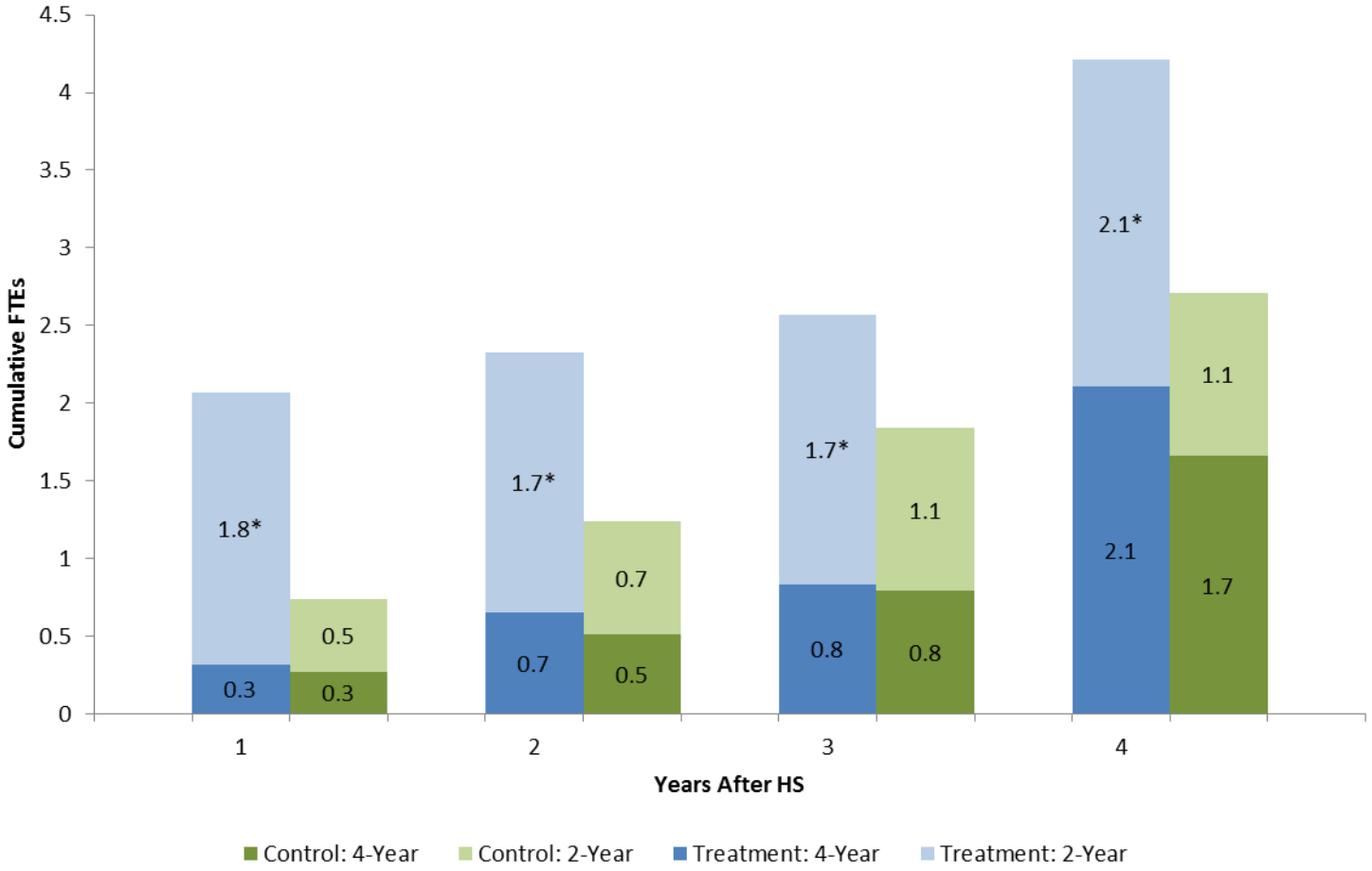
Control mean is the unadjusted group average and treatment mean is the control mean plus the impact estimate. Statistically significant treatment-control differences at the $p<0.05$ level are shown by *.

Figure 6: Cumulative FTE Years of Two-Year College Credits Earned in High School



Control mean is the unadjusted group average and treatment mean is the control mean plus the impact estimate. Statistically significant treatment-control differences at the $p<0.05$ level are shown by *.

Figure 7: Cumulative FTE Years of College Credits Earned After High School by Two- and Four-Year Institutions



Control mean is the unadjusted group average and treatment mean is the control mean plus the impact estimate. Statistically significant treatment-control differences at the $p<0.05$ level are shown by *.

Figure 8: Predicted Educational Attainment of Treatment and Control Students

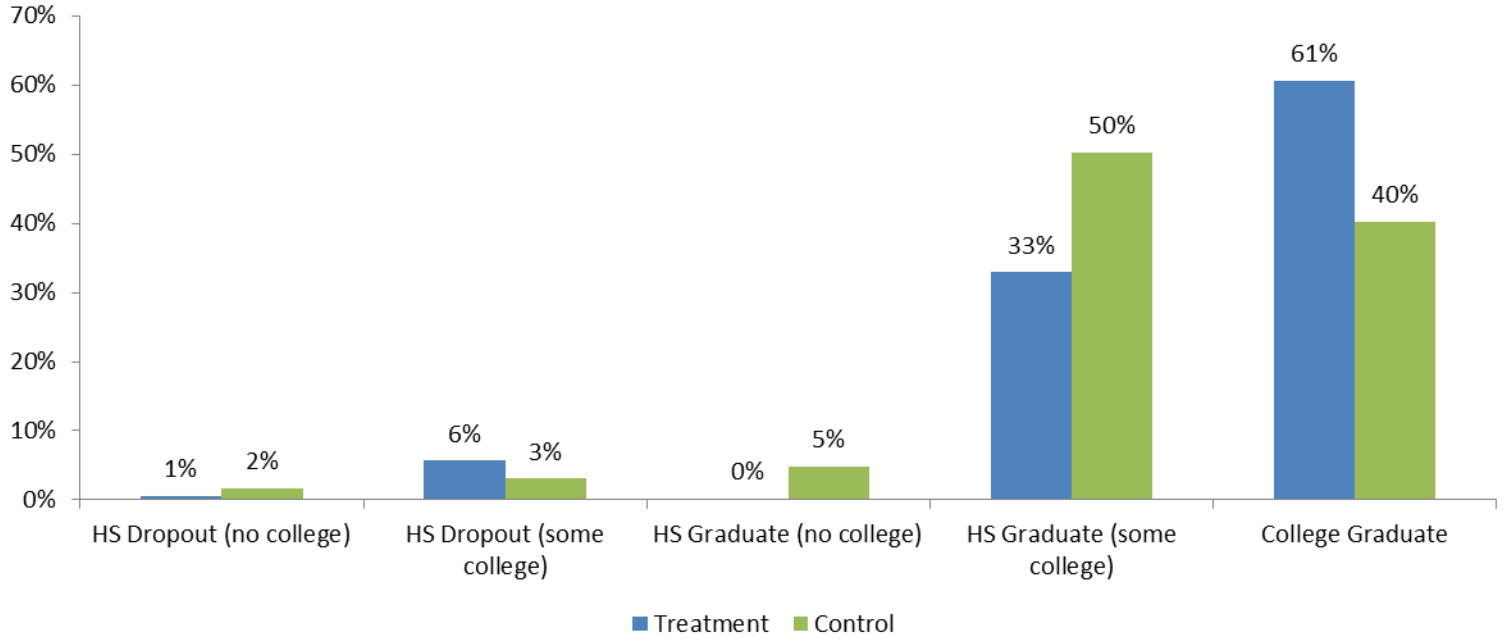
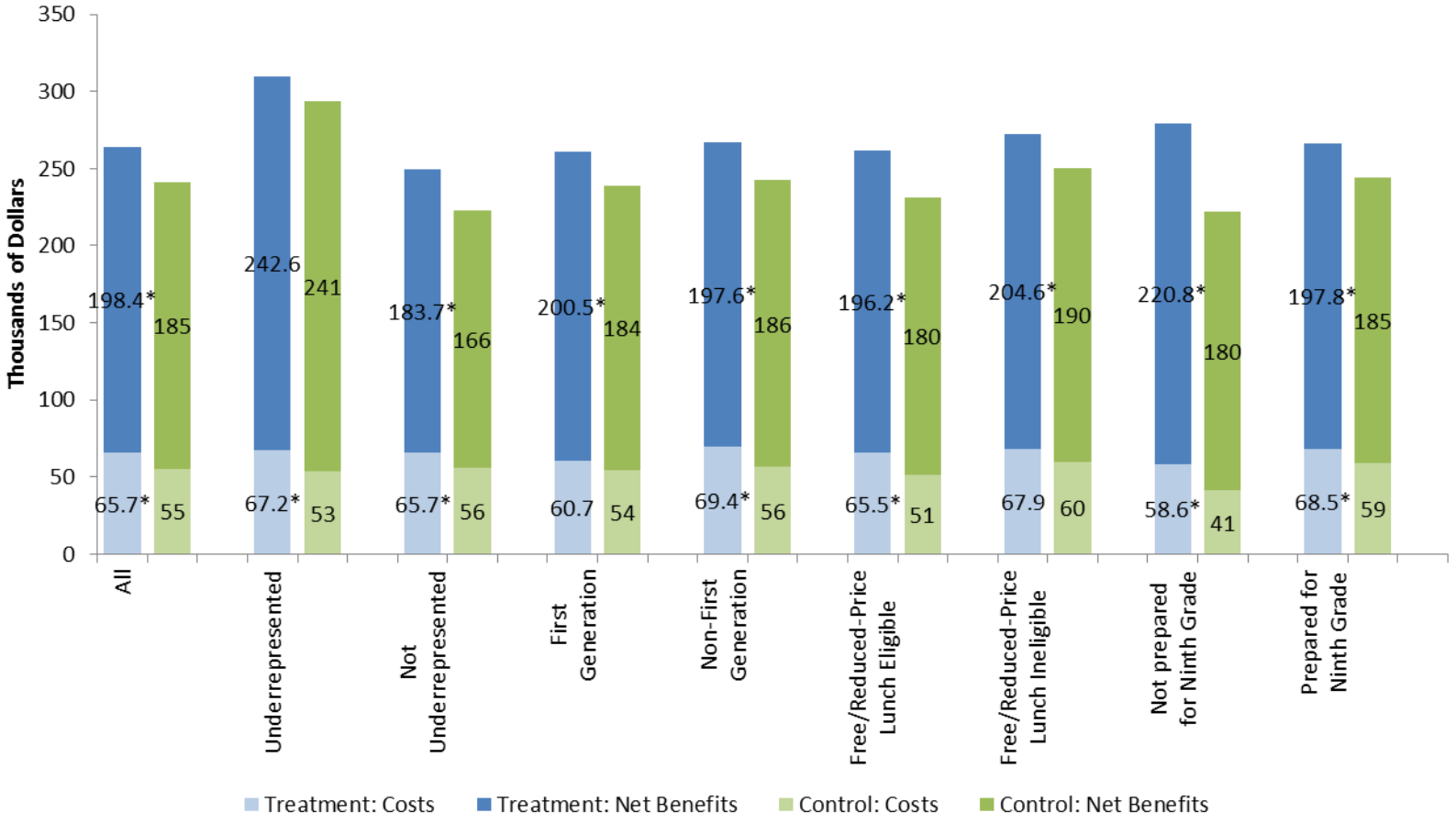


Figure 9: Benefits of Educational Attainment to Society over Study Students' Lifetime (Split into Costs and Net Benefits)



Control mean is the unadjusted group average and treatment mean is the control mean plus the impact estimate. Statistically significant treatment-control differences at the $p<0.05$ level are shown by *.

.

Table 1: Background Sample Characteristics

	Whole Sample (N=716)	***Treatment Group (N=415)***	***Control Group (N=301)***	***T-C Difference***	
	Mean	***Mean***	***Mean***	***Difference***	***P-Value***
Race & Ethnicity					
American Indian	0.5%	0.9%	0.0%	0.9%	0.088
Asian	1.3%	1.5%	1.0%	0.5%	0.595
Black	21.3%	21.6%	20.8%	0.8%	0.892
Hispanic	5.6%	5.9%	5.3%	0.5%	0.788
Multi-racial	2.9%	2.2%	3.8%	-1.6%	0.330
White	68.4%	68.0%	69.1%	-1.1%	0.764
Gender					
Male	38.3%	36.1%	41.4%	-5.3%	0.797
Age	15.34	15.32	15.37	-0.05	0.128
Exceptionality					
Disabled/ Impaired	3.9%	3.7%	4.3%	-0.6%	0.647
Gifted	12.8%	11.5%	14.9%	-3.3%	0.381
First Generation College	45.9%	44.0%	48.5%	-4.5%	0.243
Free/Reduced Price Lunch	50.5%	48.9%	52.6%	-3.6%	0.372
Retained	3.5%	2.2%	5.2%	-3.1%*	0.024
8th Grade Achievement					
Math – z-score	0.01	0.02	0.00	0.02	0.657
Reading – z-score	0.00	0.04	-0.04	0.08	0.278
Math – pass	82.2%	85.2%	78.1%	7.12%*	0.017
Reading – pass	97.8%	98.8%	96.6%	2.19%	0.048
Algebra 1 – take up	25.8%	28.1%	22.7%	5.38%	0.077
Algebra 1 – pass	97.2%	96.6%	98.2%	-1.63%	0.432
Algebra 1 – z-score	0.01	-0.01	0.04	-0.04	0.883

Notes:

[a] The proportions are weighted by students' probability of being selected into the ECHS.

[b] This is the core analytic sample used for many outcomes and excludes students who could not be found in the 9th grade administrative data.

Statistically significant treatment-control differences at the $p<0.5$ level are shown by *.