Early College, Continued Success
Early College High School Initiative Impact Study

January 2014

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Executive Summary

About the Bill & Melinda Gates Foundation's Early College High School Initiative (ECHSI)

The Bill & Melinda Gates Foundation launched the ECHSI in 2002 with the primary goal of increasing the opportunity for underserved students to earn a postsecondary credential. To achieve this goal, Early Colleges provide underserved students with exposure to, and support in, college while they are in high school. Early Colleges partner with colleges and universities to offer all students an opportunity to earn an associate's degree or up to two years of college credits toward a bachelor's degree during high school at no or low cost to the students. The underlying assumption is that engaging underrepresented students in a rigorous high school curriculum, tied to the incentive of earning college credit, will motivate them and increase their access to additional postsecondary education and credentials after high school. Since 2002, more than 240 Early Colleges have opened nationwide.

About the Study

This study focused on the *impact* of Early Colleges. It addressed two questions:

1. Do Early College students have better outcomes than they would have had at other high schools?

2. Does the impact of Early Colleges vary by student background characteristics (e.g., gender and family income)?

To answer these questions, we conducted a lottery-based randomized experiment, taking advantage of the fact that some Early Colleges used lotteries in their admissions processes. By comparing the outcomes for students who participated in admissions lotteries and were offered enrollment with the outcomes for students who participated in the lotteries but were not offered enrollment, we can draw causal conclusions about the impact of Early Colleges.

The primary student outcomes for this study were high school graduation, college enrollment, and college degree attainment. We also examined students' high school and college experiences. Data on student background characteristics came from administrative records from schools, districts, and states; data on college outcomes came from the National Student Clearinghouse (NSC).

We assessed the impact of Early Colleges on these outcomes for a sample of 10 Early Colleges that did the following:

- Enrolled students in grades 9–12 and had high school graduates between 2005 and 2011

- Used lotteries as part of the admission processes in at least one of the study cohorts (students who entered ninth grade in 2005–06, 2006–07, or 2007–08)

- Retained the lottery records

The overall study sample included 2,458 students. The study period extended through summer 2013, as far as four years past high school for the oldest students.

About This Report

In 2013, AIR released the report, *Early College, Early Success: Early College High School Initiative Impact Study*. The report was a comprehensive examination of two research questions. It relied on many data sources to examine high school and post-high-school outcomes as well as high school experiences. This report uses an additional year of postsecondary data from NSC to provide updated findings for several key postsecondary outcomes.

Key Study Findings

- **College Enrollment**

  Early College students were significantly more likely to enroll in college than comparison students. During the study period, 81 percent of Early College students enrolled in college, compared with 72 percent of comparison students. Although the gap in enrollment rates between the two groups decreased over time, comparison students' college enrollment rates did not catch up to those of Early College students during the study period. In addition, Early College students were more likely than comparison students to enroll in two-year colleges and were just as likely as comparison students to enroll in four-year colleges.

- **College Degree Attainment**

  Early College students were significantly more likely to earn a college degree than comparison students. During the study period, 25 percent of Early College students earned a college degree (typically an associate's degree), as compared with only 5 percent of comparison students.

- **Impact for Student Subgroups**

  Early College impact generally did not differ by subgroup, and when the impact differed, the difference was generally in favor of underrepresented groups. The Early College impact on college enrollment did not differ significantly by gender, race/ethnicity, family income, first-generation college-going status, or pre-high-school achievement. In other words, all student groups experienced the impact on college enrollment from attending an Early College. The Early College impact on college degree attainment did not differ based on first-generation college-going status or gender, but was stronger for minority than non-minority students, lower income than higher income students, and students with higher achievement in middle school than those with lower achievement in middle school.

Summing Up

Although the findings from this study are applicable only to the 10 Early Colleges included in the study sample, they provide strong evidence for the positive impact of Early Colleges on students. The findings in this report, which extend the study's original results by including an additional year of data, affirm the core findings: Early College students had a greater opportunity than their peers to enroll in and graduate from college. They also appeared to be on a different academic trajectory, with Early College students earning college degrees at higher rates than comparison students. In addition, Early Colleges appeared to mitigate the traditional educational attainment gaps between advantaged and disadvantaged students. Early College students were benefitting from their Early College experience beyond high school, and we expect these benefits to continue.

Introduction

The Early College High School Initiative (ECHSI), launched by the Bill & Melinda Gates Foundation in 2002, provided funds for the development of Early College High Schools (hereafter referred to as "Early Colleges"). Early Colleges offer students who are traditionally underrepresented in postsecondary education the opportunity to pursue a high school diploma while simultaneously earning college credits. The primary goal of the ECHSI is to increase students' access to a postsecondary credential. The solution offered by the ECHSI is to improve underrepresented students' likelihood of earning a college degree by providing them an opportunity to enroll in college courses while they are in high school and can receive support from high school staff.

This report updates findings from an earlier evaluation report. The evaluation sought to determine if Early College students had better outcomes than they would have had at other high schools. Using a lottery-based randomized experiment, the primary student outcomes evaluated were high school graduation, college enrollment, and college degree attainment. The first report (Berger et al., 2013) includes a detailed literature review, study design and methodology, and results on high school and college outcomes from multiple data sources. This report of updated findings covers these topics briefly, but more details are available in the earlier report.

Overview of the ECHSI

There is substantial evidence that a postsecondary degree or credential prepares students for successful entry into the workforce. Bachelor's degree holders earn more over a lifetime than individuals with only a high school diploma (Carnevale, Rose, & Cheah, 2011), and college degree earners fared better in the recent American recession than adults who held only a high school diploma (Grusky, Bird, Rodriguez, & Wimer, 2013). Moreover, workforce projections consistently predict that the lion's share of future jobs will require a postsecondary degree (Carnevale, Smith, Stone, Kotamraju, Steuernagel, & Green, 2011).

Postsecondary success therefore is the most critical goal for the ECHSI. The initiative focuses in particular on supporting underrepresented students in achieving a college credential through dual enrollment (or college during high school). Offering college courses to high school students is not unique to the ECHSI. In 2010–11, 82 percent of public high schools offered dual credit courses (Thomas, Marken, Gray, & Lewis, 2013). In addition, approximately 53 percent of postsecondary institutions reported enrolling high school students in college courses either within or outside formal dual enrollment programs in

2010–11 (Marken, Gray, & Lewis, 2013).[1] However, despite the availability of dual enrollment programs, less than 10 percent of public high school students took advantage of them in 2010–11.[2]

Early Colleges facilitate dual enrollment through established course sequences. Through the ECHSI, Early Colleges partner with colleges and universities to offer enrolled students an opportunity to earn an associate's degree or up to two years of college credits toward a bachelor's degree during high school at no or little cost to the students. The underlying assumption is that engaging underrepresented students in a rigorous high school curriculum tied to the incentive of earning college credits will motivate them and increase their access to additional postsecondary education and credentials after high school.

Early Colleges that are part of the ECHSI differ from traditional high schools in more than just offering dual enrollment. These differences are codified in the five Core Principles of the ECHSI:

1. "Early college schools are committed to serving students underrepresented in higher education."

2. "Early college schools are created and sustained by a local education agency, a higher education institution, and the community, all of whom are jointly accountable for student success."

3. "Early college schools and their higher education partners and community jointly develop an integrated academic program so all students earn one to two years of transferable college credit leading to college completion."

4. "Early college schools engage all students in a comprehensive support system that develops academic and social skills as well as the behaviors and conditions necessary for college completion."

5. "Early college schools and their higher education and community partners work with intermediaries to create conditions and advocate for supportive policies that advance the early college movement" (Jobs for the Future, 2008, p. 2).

Since 2002, more than 240 Early Colleges have opened nationwide as part of the ECHSI (Jobs for the Future, 2013). The ECHSI operates through 13 grantee organizations, or intermediaries, that receive foundation funding to work with local partners—such as school

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[1] Dual enrollment programs are formal mechanisms that enable high school students to take college courses. Many dual enrollment programs are also dual *credit* programs, in which students can earn both high school and college credits for the same course (Kleiner & Lewis, 2005). We use the term "dual enrollment" hereafter to encompass both types of programs.
[2] Calculated based on the total number of students enrolled in college during high school (Thomas et al., 2013) divided by the total number of students in high school (NCES, 2012a).

districts, community organizations, tribes, high schools, community colleges, and universities—to open Early Colleges.[3]

Overview of the ECHSI Impact Study

In 2010, the evaluation of the ECHSI started to determine the *impact* of Early Colleges. The overarching research question for the impact study was the following:

- Do Early College students have better outcomes than they would have had at other high schools?

In addition to the overall impact of Early College, the study also examined potential variation in Early College impact:

- Does the impact of Early Colleges vary by student background characteristics (e.g., gender and family income)?

We addressed these questions using a lottery-based randomized experiment, taking advantage of the fact that, starting with the second year of the ECHSI, some of the Early Colleges used lotteries in their admissions processes. Earlier descriptive studies (see, for example, AIR & SRI, 2009) found consistently positive experiences and outcomes for Early College students, but we could not determine whether the positive findings were attributable to the characteristics of the students who chose to attend Early Colleges or to the Early Colleges themselves. In a lottery study, the only difference between lottery applicants who were offered enrollment ("won the lottery") and lottery applicants who were not offered enrollment ("lost the lottery") is the outcome of the lottery itself. By comparing outcomes for students who were offered enrollment with those who were not offered enrollment, we can draw valid causal conclusions about the impact of Early Colleges.

The primary student outcomes for this study are consistent with the goals of the ECHSI (Bill & Melinda Gates Foundation, 2009). The outcomes include whether students

- graduated from high school,
- enrolled in college, and
- earned a college certificate or degree (either during their time in high school or afterward).

The earlier report includes findings on all three of these primary outcomes. This report updates the college enrollment and college degree attainment findings by examining student

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[3] Organizations other than the 13 supported by the foundation have opened Early Colleges. For example, the state of Michigan has started Early Colleges (Hoffman & Webb, 2009).

outcomes for an additional academic year, a period of time that covers up to four years after high school. We drew on student record data from the National Student Clearinghouse (NSC) to measure students' postsecondary outcomes.[4]

The study design is retrospective: we sought sites that conducted lotteries far enough in the past that students who had entered Early Colleges at the time the lotteries were conducted would have had the opportunity to graduate from high school and enter postsecondary education by the time data collection concluded. The retrospective feature of the design made it possible to estimate the impact on postsecondary outcomes within a reasonably short time frame. The study included a sample of 10 Early Colleges that (1) enrolled students in grades 9–12 and had high school graduates between 2005 and 2011, (2) used lotteries in their admission processes in at least one of the study cohorts (ninth graders in 2005–06, 2006–07, or 2007–08), and (3) retained the lottery records.

This study followed students from ninth grade through up to four years after high school. Exhibit 1.1 displays the progression through high school for each cohort (for students who progressed at the expected pace). Study cohorts are numbered based on the year in which students entered ninth grade:

- Cohort 1 students entered ninth grade in 2005–06 and were expected to graduate in 2008–09 if they progressed at the typical pace.

- Cohort 2 students entered ninth grade in 2006–07 and were expected to graduate in 2009–10.

- Cohort 3 students entered ninth grade in 2007–08 and were expected to graduate in 2010–11.

The NSC data cover student college outcomes through summer 2013,[5] and therefore follow all students in the study through two years beyond expected high school graduation (and three years for Cohort 2 and four years for Cohort 1).

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[4] The National Student Clearinghouse (NSC) collects data from higher education institutions across the country. Data are collected on student enrollments and degree completions. The data cover over 90 percent of all student enrollments in public and private colleges and universities (NSC, 2013; Dynarski, Hemelt, & Hyman, 2013). NSC data provide conservative estimates of college enrollment and degree attainment. If a student did not have a record in the NSC, then that student was coded as not being in college. However, students may be missing from the NSC because (a) they attend a college that does not provide data to NSC, (b) they did not allow NSC to share their individual record data, (c) their name or birthday in our record did not match that in the NSC, or (d) the institution has not yet reported enrollment and graduation records to NSC. We have no reason to expect NSC data to be differentially missing for treatment and comparison students. One exception is that there is evidence that dual enrollment students (students enrolled in college while in high school) may be underrepresented in NSC data (Dynarski, Hemelt, & Hyman, 2013). Therefore, these findings are conservative estimates of students' college enrollments while in high school.
[5] Note that for the previous report the only data available for the 2012–13 year were the fall enrollments. We did not have enrollment or degree attainment data for the full academic year.

Exhibit 1.1. Study Cohorts and Students' Expected Progression

Cohort	2005–06	2006–07	2007–08	2008–09	2009–10	2010–11	2011–12	2012–13
1	Year 1 9th	Year 2 10th	Year 3 11th	Year 4 12th	Year 5 1st post-HS	Year 6 2nd post-HS	Year 7 3rd post-HS	Year 8 4th post-HS
2		Year 1 9th	Year 2 10th	Year 3 11th	Year 4 12th	Year 5 1st post-HS	Year 6 2nd post-HS	Year 7 3rd post-HS
3			Year 1 9th	Year 2 10th	Year 3 11th	Year 4 12th	Year 5 1st post-HS	Year 6 2nd post-HS

NOTE: This table displays a traditional educational progression. Students may take more or less time to complete high school.

In our study, we defined "Early College students" (or treatment students) as all students who were offered admission to the Early College from a lottery prior to the first day of school. Our comparison students included all students who participated in the lottery but were not offered admission to the Early College prior to the first day of school. Random assignment to the Early College or comparison condition is not the same as attending or not attending an Early College. Early College students may not have attended an Early College (i.e., "no-shows"), and comparison students may have attended an Early College (i.e., "crossovers"). Across the 10 study sites, the no-show rate was 22 percent and the crossover rate was 2 percent.[6]

Exhibit 1.2 lists the number of Early College and comparison students for each cohort year. The previous report (Berger et al., 2013) includes details about the size, location, and academic programs of the study's Early Colleges and comparison schools.

Exhibit 1.2. Number of Early Colleges and Number of Students in Study Sample, by Cohort Year

Cohort Year	Number of Early Colleges	Number of Early College Students	Number of Comparison Students
2005–06	3	133	343
2006–07	7	431	551
2007–08	7	480	520
TOTAL	10*	1,044	1,414

* Some Early Colleges had multiple participating cohorts; therefore the number of Early Colleges across the three cohorts is more than the total number of Early Colleges in the study sample.

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[6] For more information about compliance to treatment assignment and the sensitivity analyses performed to address this issue, please refer to the original study report (Berger, et al., 2013).

The results of our impact study rely on the assumption of random assignment during the lottery process. To verify that students who were selected to attend the Early College did not systematically differ from comparison students, we examined the baseline equivalence of the two study groups for a variety of student background characteristics, including gender, minority status, eligibility for free or reduced-price lunch, first-generation status, and English language arts (ELA) and mathematics test scores prior to high school.[7] The tests of group equivalence in individual student characteristics show that the two groups were not significantly different in any characteristic except in prior ELA scores (see Exhibit 1.3). The single significant difference was likely due to chance. Additional details on baseline equivalency are in the previous report (Berger et al., 2013).

Exhibit 1.3. Background Characteristics of Early College and Comparison Students and Group Differences

Characteristics	Early College	Comparison	Difference
Female	51.8%	55.0%	-3.2%
Minority[a]	52.4%	53.6%	-1.2%
First-generation college going	30.7%	34.4%	-3.7%
Low income	46.5%	42.3%	4.2%
Prior achievement in ELA	.25	.15	.11**
Prior achievement in math	.23	.29	-.07

n = 2,458 students (1,044 Early College, 1,414 comparison)
NOTES: All data are from administrative data sources except for first-generation status, which comes from the student survey. Early College group means are unadjusted means, and comparison group means were computed by subtracting the estimated group difference from the unadjusted Early College group means. Prior achievement scores were converted to z-scores and were standardized using publicly available statewide assessment means and standard deviations. The values in the Difference column may not match the difference between the Early College and Comparison group means due to rounding.
[a] Among students who were minority, 73.3 percent were Black, 20.2 percent were Hispanic, 2.9 percent were Asian or Pacific Islander, 2.9 percent were multi-racial, and .8 percent belonged to another ethnic or racial group.
* $p < .05$; ** $p < .01$; *** $p < .001$

This study was designed to assess the impact of the Early Colleges on a variety of student outcomes during high school and beyond. To address our first research question, we estimated the impact of Early Colleges on students who were *offered admission* to an Early College based on a lottery. To address our second research question, we examined the degree to which the impact of Early Colleges differed for students with different background characteristics. In all models used to address these research questions, we included the following baseline covariates: female, minority, first generation, low income, prior

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[7] We also collected student-level data about English language learner (ELL) status and Individualized Education Plan (IEP) status before entering high school. However, only a small proportion of students in our sample were ELLs (less than 1 percent) or had IEPs (7 percent); therefore we did not include these two variables in the baseline equivalence analyses or as covariates in the impact analyses.

achievement in ELA, and prior achievement in mathematics. The analysis details are described in more detail in Appendix A and in the previous report (Berger et al., 2013).

Due to the purposeful sample of schools, the study findings cannot be generalized to schools and students outside the study sample. However, our focus on Early Colleges for which we could verify a random lottery process allowed us the unique opportunity to compare the outcomes of students who were randomly selected to attend an Early College with the outcomes of students who were in the pool of potential students, but were not selected for enrollment through the lottery. By taking advantage of this naturally occurring experiment, we were able to observe the counterfactual, or the outcome that lottery winners would have experienced had they not been randomly selected to attend the Early College. Despite its limited external validity, this study enables us to draw causal conclusions about the impact of Early College through a rigorous design with strong internal validity.

In this set of updated findings, we report the estimated impact of Early Colleges on student outcomes related to college enrollment and degree attainment with an additional year of postsecondary data. We examine both outcomes (college enrollment or degree attainment) in three ways:

1. Whether the student had the outcome at any point during the study period (this includes two academic years after typical high school completion for our youngest cohort and four academic years after high school completion for our oldest cohort).

2. Whether the student had the outcome by the end of the *second* year after typical high school completion (this is the timeframe during which we have data for all students in the study).

3. Whether the student had the outcome by the end of the *third* year after typical high school completion for the two oldest cohorts of students. Although these analyses include a subset of the total sample (and are set apart from the main text in the report), they enable us to study student outcomes for an additional year and, as a result, better understand potential enrollment and degree attainment patterns.

Exhibit titles and notes specify the sample size and cohorts reflected in the findings.

The Early College group means are unadjusted means. Comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College group means. Thus, the comparison group means represent the outcomes that would have been expected had the Early College students been assigned to the comparison condition. All estimates are updated from the previous report. Where findings differ from the previous report, we note the change in the text. Appendix B provides more detailed findings, including estimated effect sizes, from all impact analyses.

Early College Impact on Postsecondary Outcomes

The ultimate goal of the ECHSI is for students to earn a postsecondary degree or credential that prepares them for successful entry into the workforce. This report builds on the study's original findings to further examine the effectiveness of Early Colleges in improving key college outcomes for students: college enrollment and degree attainment.
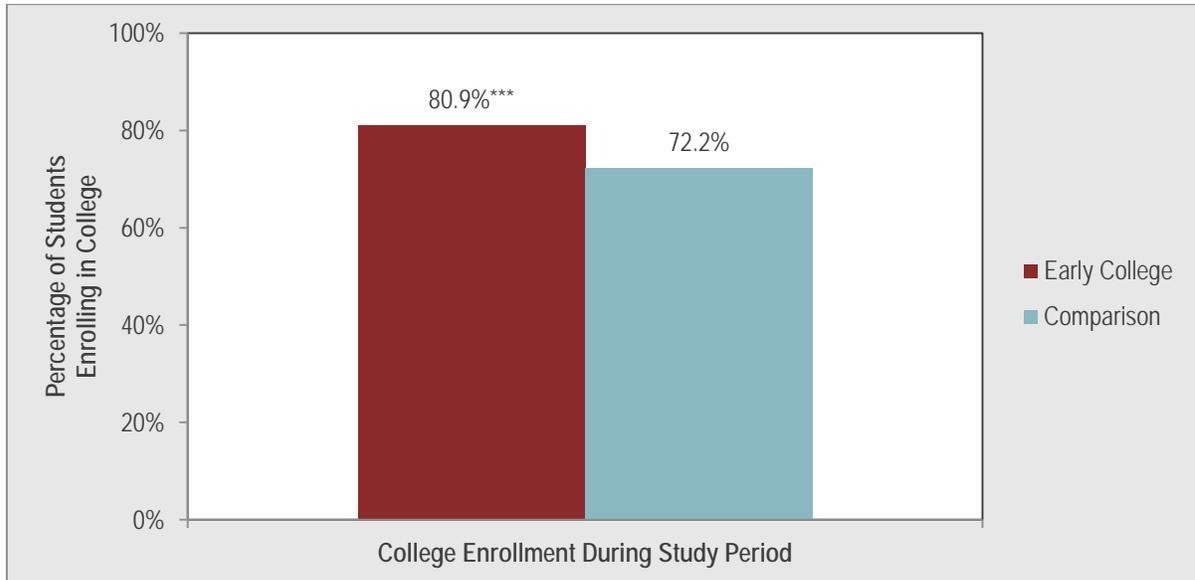
This chapter presents the impact of being admitted to an Early College on student outcomes. Our previous report (Berger et al., 2013) included academic achievement and graduation rates from high school. Because students had already completed their high school careers when that report was released, those findings remain unchanged and are not addressed again in this report. To update the findings of the original report with an additional academic year of postsecondary enrollment and graduation data, we report the findings for college outcomes, including enrollment and degree attainment. In addition to the overall Early College impact on these outcomes, we also examine whether the Early College impact on college enrollment and degree attainment differed for students with different background characteristics.

College Enrollment

Because Early Colleges build college course-taking into their design, we should expect Early College students to enroll in college courses at higher rates during their high school years than comparison students. However, Early College and comparison students alike had the opportunity to enroll in college following high school graduation. Therefore, in our impact analyses, we examined whether students in the study enrolled in college at any point during our study period (through summer 2013).[8] We found that being admitted to an Early College had a statistically significant positive impact on college enrollment: 80.9 percent of Early College students had at least one record of college enrollment, roughly 9 percentage points higher than the 72.2 percent college enrollment rate for comparison students (see Exhibit 2.1). Our analyses of differential Early College impact indicated that the Early College impact on college enrollment was similar for students with different background characteristics (i.e., gender, minority status, first-generation college-going status, low-income status, or prior achievement). See Appendix B for detailed results from the differential impact analyses.

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[8] Therefore, students in the oldest cohort have had a longer period of time to enroll in and graduate from college compared to students in the youngest cohort. In our models, we account for this difference—Early College and comparison students are only compared within each cohort.

Exhibit 2.1. Percentage of Students Who Enrolled in College at Least Once During Study Period, by Study Group

n = *2,458 students (1,044 Early College, 1,414 comparison)*
SOURCE*: National Student Clearinghouse, 2005–2013*
NOTES*: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.*
* p < .05; ** p < .01; *** p < .001

To cast further light on the impact of Early Colleges on college attendance, we moved beyond overall measures of college degree attainment to examine degree attainment by Year 4, Year 5, and Year 6.[9] The enrollment rates by Year 4 reflect the time period when students would traditionally still be in high school. By this point in time, Early Colleges had a significant impact on rates of college enrollment: 63.5 percent of Early College students had at least one record of college enrollment during high school, compared with 24.3 percent of comparison students (see Exhibit 2.2).[10]

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[9] For students following a traditional trajectory, the fourth, fifth, and sixth years would represent the final year of high school, the first year after high school, and the second year after high school, respectively. By referring to the number of years after beginning ninth grade, we were able to examine our entire sample on the same playing field, including those students who dropped out of high school, those who took extra time to earn their high school diploma, and those for whom we lacked high school graduation data.

[10] Note that these figures are slightly different than those presented in AIR's previous report (Berger et al., 2013). NSC data available to researchers changes over time as students change their status to allow or disallow data sharing (Dynarski, Helmet, & Hyman, 2013). It is likely that all college outcomes reported here are conservative estimates of actual enrollment and graduation numbers.

Exhibit 2.2. Percentage of Students Who Enrolled in College by Year 4, by Year 5, and by Year 6 After Starting Ninth Grade for All Cohorts, by Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
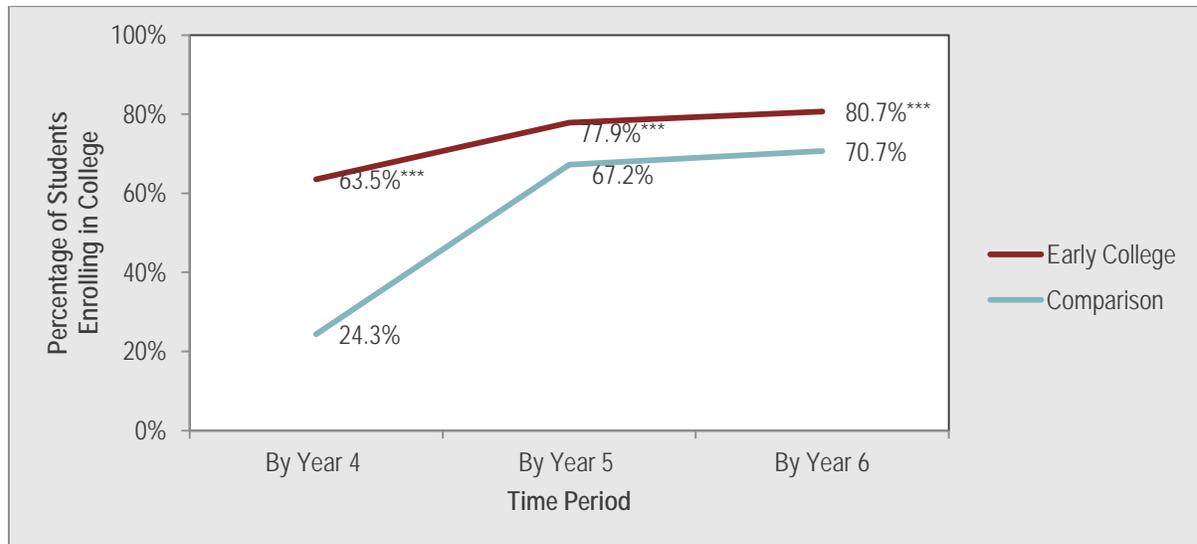* p < .05; ** p < .01; *** p < .001

We also examined enrollment rates by the end of Years 5 and 6. Year 5 represents a timeframe when all students on a traditional trajectory would have had an opportunity to finish high school and to enroll in college after high school completion.[11] Year 6 represents the latest point in time for which we have data for all study cohorts. By the end of Year 5, 77.9 percent of Early College students and 67.2 percent of comparison students had enrolled in college (see Exhibit 2.2).[12] By the end of Year 6, 80.7 percent of Early College students and 70.7 percent of comparison students had done the same. Between Year 4 and Year 6, the gap between the groups narrowed from 39.2 to 10.0 percentage points. Despite this decrease in the gap, the difference between the two groups remained statistically significant.

Although Year 6 (two years past high school) is the last point for which the entire study sample had data available, we had data for three years beyond high school (i.e., Year 7) for the two oldest cohorts. The *College Enrollment Trends for the Two Oldest Cohorts* text box explores enrollment patterns for these two cohorts.

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[11] Some students in the study—primarily those attending Early Colleges—attended a school with an optional fifth year. Therefore, while most students will have completed high school before Year 5, the Year 6 timeframe represents a year by which all students should have had an opportunity to move on from high school.
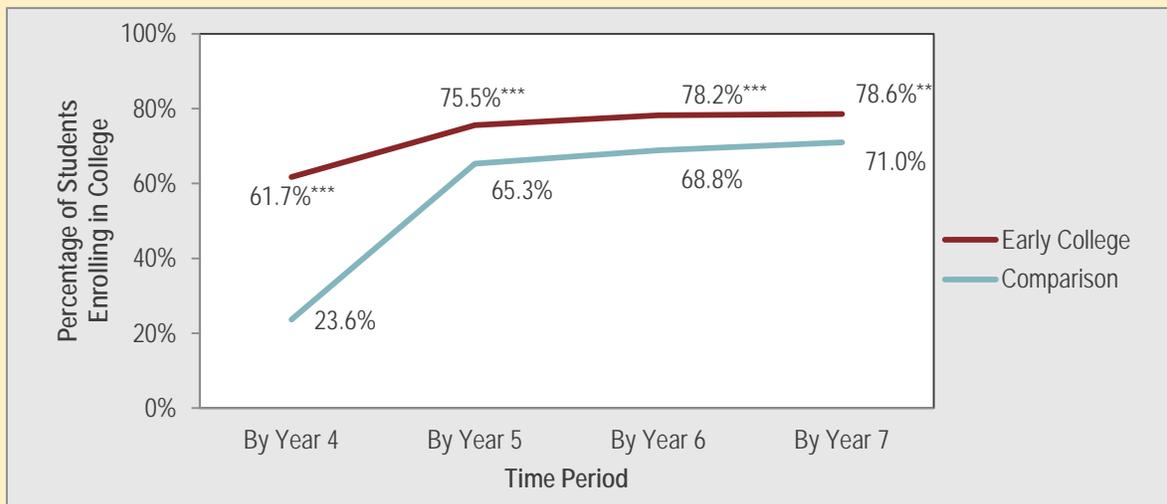[12] These data suggest that 14.3 percent of Early College students (the difference between the percentages in Year 4 and Year 5) enrolled in college for the first time in Year 5, and that 43.8 of comparison students did the same.

College Enrollment Trends for the Two Oldest Cohorts

Two study cohorts have data available for seven years after entering ninth grade. By examining student outcomes for three years past typical high school graduation, we are able to get a sense of what we might observe if we were to track the full study sample for additional years.

College enrollment rates increased for both Early College and comparison students between Year 4 and Year 7, with comparison students closing a sizeable portion of the gap in Year 5—the period of time during which students on a traditional trajectory would have completed high school and had the opportunity to move on to college. Although the gap in enrollment rates between the two groups declined from 38.1 percentage points in Year 4 to 7.6 percentage points by the end of Year 7, differences in all four years were statistically significant. These findings suggest that while the gap between the groups narrowed after the conclusion of high school, comparison students had not caught up to their Early College counterparts by three years after high school.

Percentages of Students Who Enrolled in College by Number of Years After Starting Ninth Grade for the 2005–06 and 2006–07 Cohorts, by Study Group

n = 1,458 students (564 Early College, 894 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
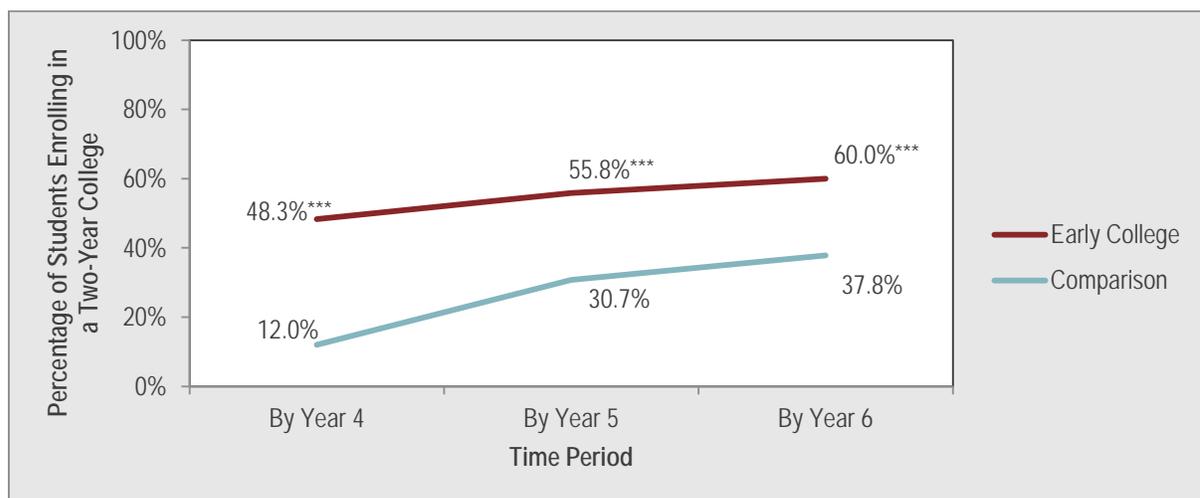* p < .05; ** p < .01; *** p < .001

In addition to examining *whether* and *when* students enrolled in college, we also examined *where* they enrolled. Our descriptive studies indicate that Early Colleges primarily partner with two-year institutions of higher education: 76 percent of Early Colleges in the ECHSI in 2007–08 partnered with two-year colleges, while 35 percent partnered with four-year

colleges; 11 percent partnered with both (AIR & SRI, 2009). The study sites have a similar composition: 8 of 10 Early Colleges partnered with two-year colleges, 2 partnered with four-year colleges, and 1 partnered with both.[13] The fact that the majority of Early Colleges partnered with two-year colleges has led to the criticism that Early Colleges may funnel students primarily into two-year colleges and away from educational pathways that would lead to a bachelor's degree.

Our results indicate that being admitted to an Early College had a statistically significant positive impact on attending a two-year college. The percentage of Early College students who attended a two-year college during the study period (60.8 percent) was significantly higher than the percentage for comparison students (40.0 percent). This difference might be expected, particularly during the high school years, when Early Colleges frequently partner with local two-year institutions. Exhibit 2.3 displays the two-year enrollment percentages over time. Indeed, a gap of more than 36 percentage points existed between the two groups by the end of Year 4 (48.3 percent for Early College students and 12.0 percent for comparison students), which would mark the end of the high school experience for students on a traditional trajectory. The gap shrank to about 22 percentage points (60.0 percent for Early College students and 37.8 percent for comparison students) by the end of Year 6, but it remained statistically significant.

Exhibit 2.3. Percentage of Students Who Enrolled in a Two-Year College by Year 4, by Year 5, and by Year 6 After Starting Ninth Grade for All Cohorts, by Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
* $p < .05$; ** $p < .01$; *** $p < .001$

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[13] To place these figures in the national context, 29 percent of full-time college enrollments in fall 2010 were at two-year institutions and 71 percent were at four-year institutions; 65 percent of part-time fall college enrollments in fall 2010 were at two-year institutions and 35 percent were at four-year institutions (NCES, 2012b).

We also explored the trend for enrollment at four-year colleges. If Early Colleges funnel students primarily toward two-year institutions, we might see lower rates of four-year college attendance for Early College students than for comparison students. In fact, being admitted to an Early College did not have an impact on attending a four-year college during the study period. The percentage of Early College students who attended a four-year college (54.4 percent) was not significantly different than the percentage for comparison students (50.1 percent). This finding differs from our previous report, which found that Early College students were more likely to have enrolled in a four-year institution than comparison students. Examining enrollment rates over time sheds light on potential explanations for the change in this finding.

Although the overall enrollment rates did not differ, the enrollment patterns differed significantly (see Exhibit 2.4). Starting in Year 4, the two groups differed significantly (14.8 percentage points). By Year 5, the gap narrowed and was no longer significant. However, by Year 6, the significant gap re-emerged (by 7.0 percentage points). Our data do not enable us to determine the reason for this trend. One possibility is that Early College students continued to attend two-year colleges to complete an associate's degree, then progressed to four-year colleges after attaining a degree. If this were the case, the increase in the gap between the groups by Year 6 could reflect Early College students' transition to four-year institutions.

Exhibit 2.4. Percentage of Students Who Enrolled in a Four-Year College by Year 4, by Year 5, and by Year 6 After Starting Ninth Grade for All Cohorts, by Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
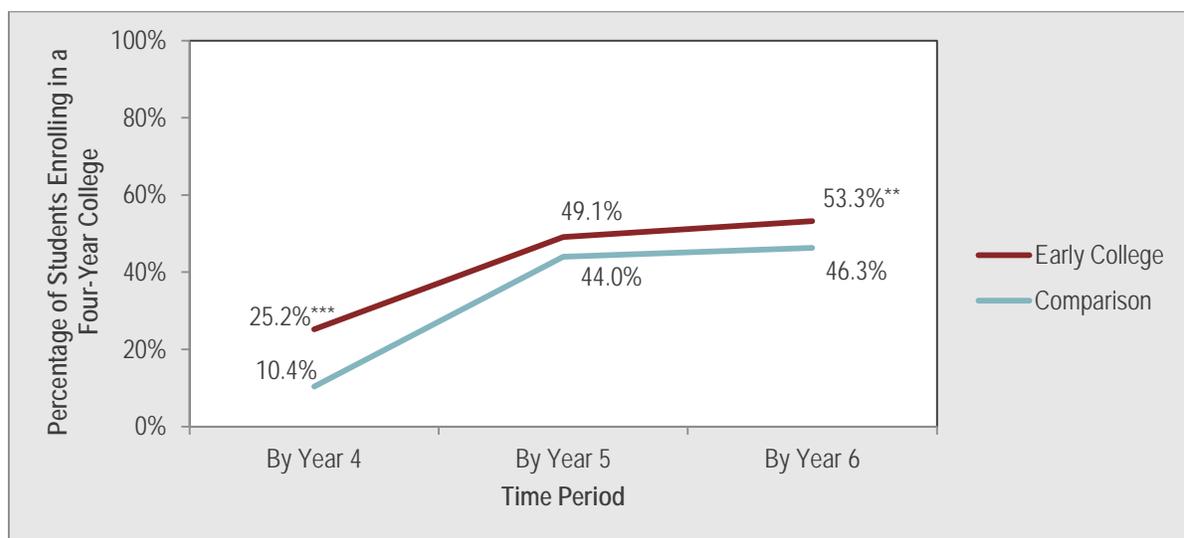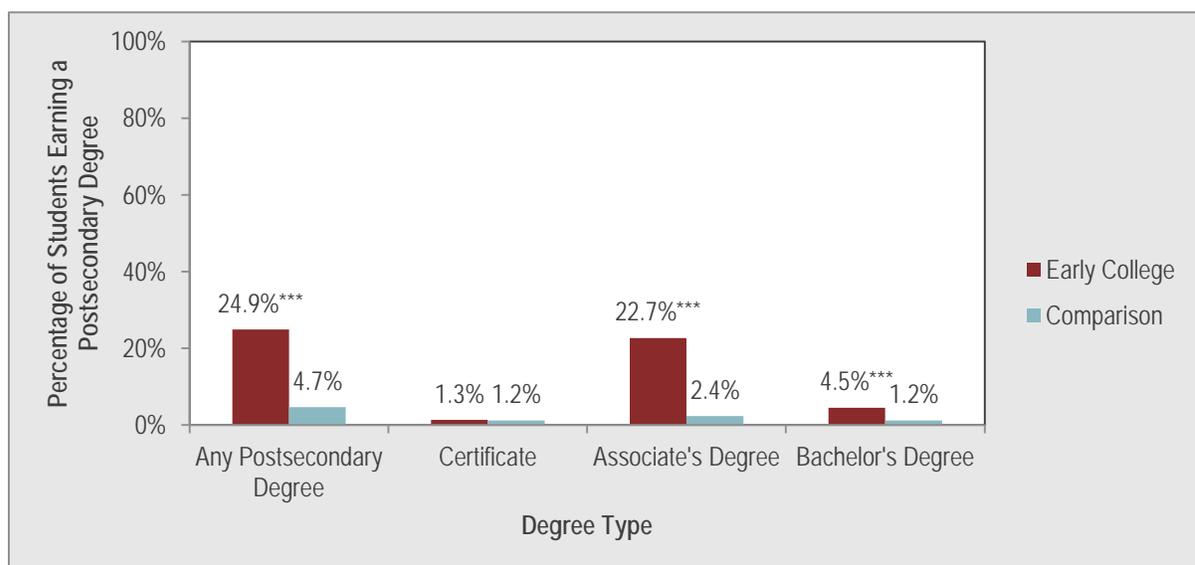* p < .05; ** p < .01; *** p < .001

The findings for four-year enrollments are particularly important because disadvantaged students are less likely to enroll in a four-year institution, even if academically prepared. For example, Horn and Nuñez (2000) found that even after controlling for academic qualifications, first-generation students were less likely than their peers to enroll in a four-year college. Nevertheless, the study findings continue to suggest that Early Colleges were *not* guiding students away from postsecondary paths that would lead to a bachelor's degree.

Degree Attainment

The results above describe student college attendance. Enrollment, however, is important only as an indicator of students' likelihood of attaining a postsecondary credential or degree. Research and job projections continue to highlight a college degree as the key to meaningful participation in the workforce, resulting in increased earning potential and opportunity for advancement. Thus, the fundamental question for the study is whether Early College students were more likely to earn a postsecondary degree.

The results indicate that being admitted to an Early College had a statistically significant positive impact on degree attainment. By the end of the 2012–13 academic year, 24.9 percent of Early College students had earned a postsecondary degree, compared with 4.7 percent of comparison students (see Exhibit 2.5).

Exhibit 2.5. Percentage of Students Earning a Postsecondary Degree During the Study Period, by Degree Type and Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
* p < .05; ** p < .01; *** p < .001

The significant positive treatment effect held for associate's and bachelor's degrees, but not for certificates. About one quarter of Early College students (22.7 percent) earned an associate's degree, compared with 2.4 percent of comparison students (see Exhibit 2.5). Bachelor's degree attainment understandably occurred at lower rates, as only the oldest cohort in our study had an opportunity to attend college for the four years after high school that a bachelor's degree traditionally requires. Nevertheless, a significant difference between the study groups existed, with 4.5 percent of Early College students earning a bachelor's degree and only 1.2 percent of comparison students doing the same.[14] Certificate attainment for the two groups of students was similar, with few students in either group earning a certificate (1.3 percent of Early College students and 1.2 percent of comparison students). The majority of certificate programs require one year of coursework or less to complete, meaning that students in the study should have had the opportunity to complete a certificate program if that was their desired path. The low rate of certificate attainment for both groups suggests that students in the study who pursued a college education did so primarily by enrolling in degree-granting programs.

In addition to the overall effect of Early Colleges on degree attainment, we also examined whether the Early College effect differed by student background characteristics (Research Question 2). Although the effect of Early Colleges on degree attainment was similar for males and females and for first-generation students and non-first-generation students, it differed significantly for the student subgroups defined by the following characteristics:

- *Race:* The Early College impact on college degree attainment was significantly stronger for minority than for white students. Among minority students, Early College students were nearly 10 times more likely to obtain a college degree than comparison students (29.4 percent vs. 3.0 percent). Among white students, Early College students were approximately 4 times more likely to obtain a college degree than comparison students (25.8 percent vs. 6.5 percent).

- *Income:* The Early College impact on college degree attainment was significantly stronger for low-income students. Specifically, low-income Early College students were approximately 8.5 times more likely than low-income comparison students to obtain a college degree (22.1 percent vs. 2.6 percent). In contrast, higher income Early College students were approximately 4 times more likely to obtain a degree than higher income comparison students (27.6 percent vs. 7.2 percent).

- *Prior Achievement:* The impact of Early College on college degree attainment was significantly stronger for students who entered high school with better mathematics and ELA scores. The difference between Early College students and comparison

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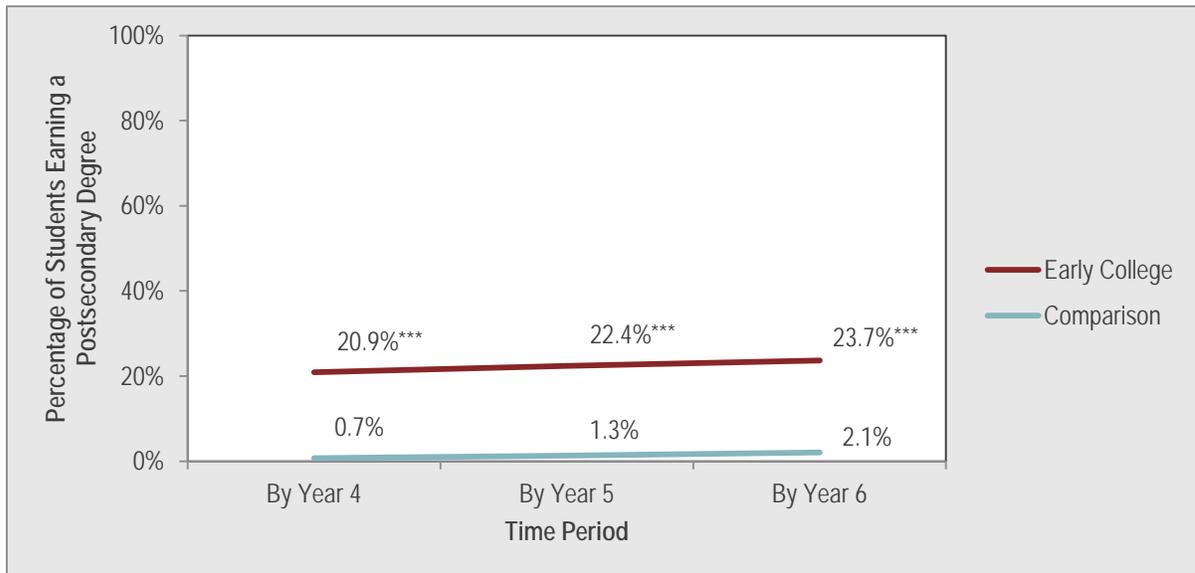[14] Note that the sum of the percentage of Early College students earning associate's degrees and bachelor's degrees exceeds the overall percentage of students earning any degree because many of the students who earned a bachelor's degree had already earned an associate's degree.

students was smallest among students with lower prior ELA and mathematics test scores and largest among students with higher ELA and mathematics test scores.

Appendix B provides additional details for these analyses. Note that one difference exists between the results presented here and those in the original study: We originally reported that the Early College impact on college degree attainment was stronger for females. Our updated analyses no longer find a differential impact based on gender.

As we did for college enrollment, we moved beyond overall measures of college degree attainment to examine degree attainment by Year 4, Year 5, and Year 6. The data suggest that the overwhelming majority of Early College students who had earned a college degree by this point did so during high school. Of all Early College students, 20.9 percent had received at least one degree by Year 4, 22.4 percent had received at least one degree by Year 5, and 23.7 percent had received at least one degree by Year 6 (see Exhibit 2.6). In contrast, very few comparison students had earned a college degree by the same points in time (0.7 percent, 1.3 percent, and 2.1 percent, respectively). Of course, it will be important to follow the students in all cohorts at least through four years after high school, and perhaps even longer, to see the eventual differences in degree attainment rates. See the *College Degree Attainment Trends for the Two Oldest Cohorts* text box for degree attainment patterns through Year 7 for our two oldest cohorts.

Exhibit 2.6. Percentage of Students Who Earned a Postsecondary Degree by Year 4, by Year 5, and by Year 6 After Starting Ninth Grade for All Cohorts, by Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
* p < .05; ** p < .01; *** p < .001

College Degree Attainment Trends for the Two Oldest Cohorts

We again explore data for our two oldest cohorts, which have data available for seven years after beginning ninth grade. These analyses are suggestive of what we might see if we could track the full study sample for additional years.

The percentage of Early College students who earned a postsecondary degree increased from 17.7 percent by the end of Year 4 to 22.2 percent by the end of Year 7. In contrast, the percentage of comparison students who completed a postsecondary degree increased from 0.4 percent to 4.8 percent over the same time period, for a gap of over 17 percentage points between the two groups by Year 7. This difference remained stable and statistically significant; comparison students had not caught up to their Early College counterparts as of three years after high school.

Percentage of Students Who Attained a College Degree by Years After Starting Ninth Grade for the 2005–06 and 2006–07 Cohorts, by Study Group

n = 1,458 students (564 Early College, 894 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison means were computed by subtracting estimated treatment effects from the unadjusted Early College means.

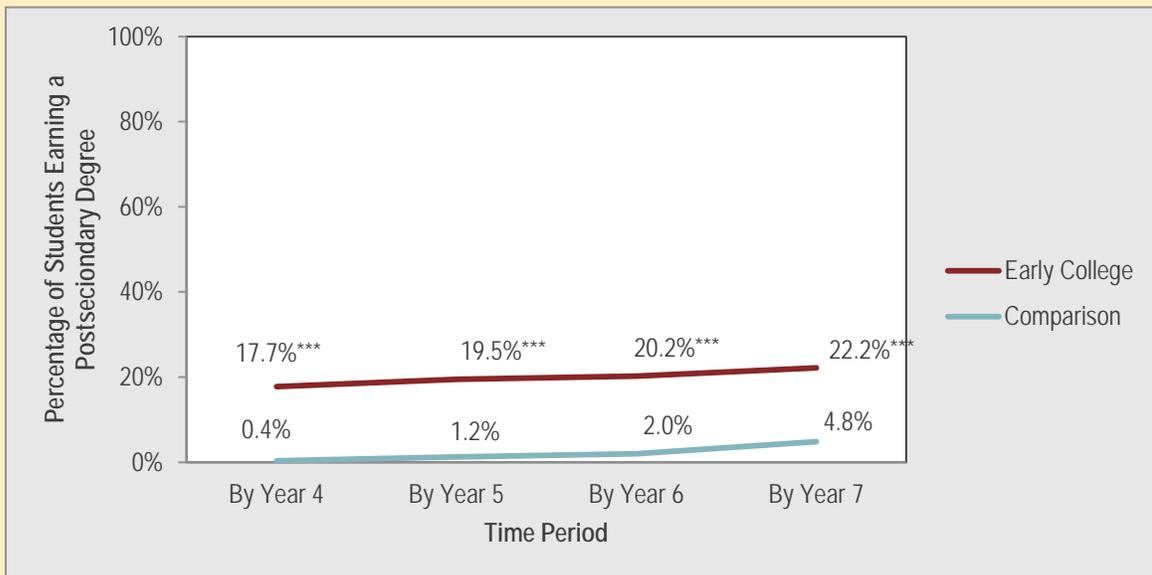* $p < .05$; ** $p < .01$; *** $p < .001$
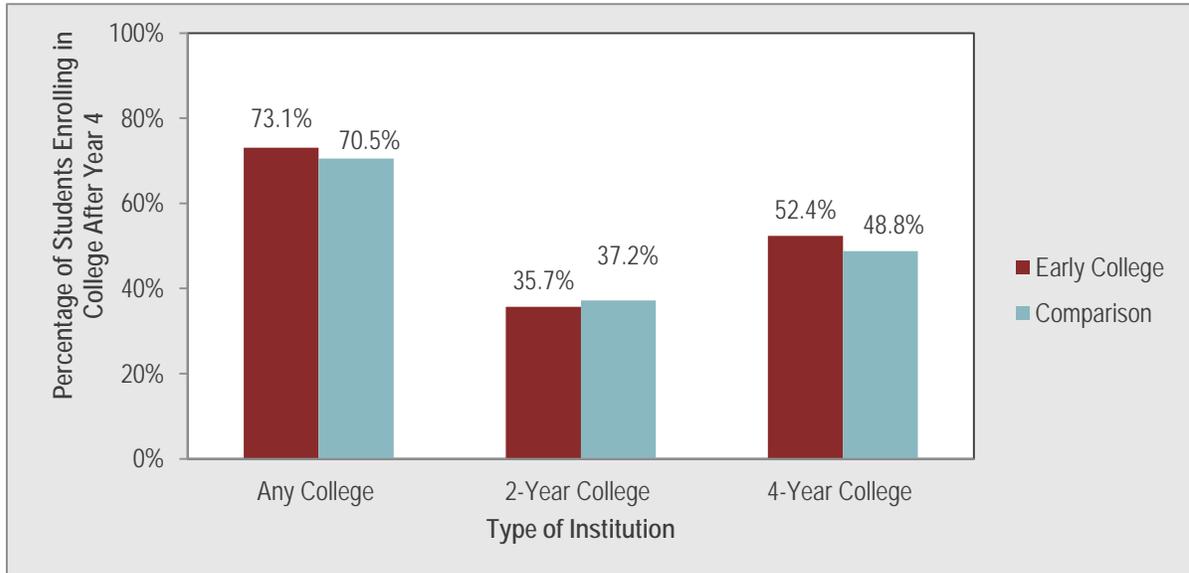
College After High School

Our findings for college enrollment and degree attainment suggest that most of the difference between the two study groups took place within four years after starting ninth grade, or during high school. Although some of the gaps shrank after high school, especially for college enrollment rates (as one might expect), the gaps persisted and remained statistically significant through the end of Year 6; we found no evidence that the comparison students caught up to their Early College peers. However, the findings raise an important question: what impact do Early Colleges have after students leave the highly structured and scaffolded high school environment? Because we tracked our full study sample only through the end of Year 6, our data do not allow us to make inferences about the long-term degree attainment rates that would be most useful for answering this question. Nevertheless, we explored post-high school outcomes to better understand the impact of Early Colleges. For the purposes of this discussion, "after high school" refers to the period of time after the end of Year 4.[15]

We first examined college enrollment after the end of Year 4, and found no statistically significant difference between the rates for Early College students (73.1 percent) and comparison students (70.5 percent; see Exhibit 2.7).[16] In other words, the Early Colleges impacted college enrollment during high school (an impact which remained over time), rather than impacting college enrollment after high school. Students in both groups also attended two-year colleges at comparable rates after Year 4, with 35.7 percent of Early College students and 37.2 percent for comparison students. Likewise, students in both groups attended four-year colleges at comparable rates after Year 4, with 52.4 percent of Early College students and 48.8 percent of comparison students. This finding represents a departure from the findings in the previous report, which revealed a statistically significant difference between the groups in four-year college enrollment after high school, with Early College students attending four-year colleges at higher rates. However, the central point remains: despite the fact that Early Colleges partnered primarily with two-year colleges, Early College students did not appear to enroll in two-year colleges at the expense of four-year college enrollment.

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[15] For students following a traditional trajectory, these post-Year 4 outcomes should correspond to the years after high school. However, as noted in the original report, some students participate in five-year high school programs and might still be in high school after the conclusion of Year 4.

[16] We use Year 4 here rather than high school graduation to take full advantage of available data; whereas we have Year 4 outcomes available for all students in our study, students who drop out of high school or lack graduation dates in our data would otherwise need to be dropped from our analysis, thus lowering our sample size for these variables. Sensitivity analyses that used the high school graduation date instead of Year 4 to define "after high school" produced college enrollment rates that were higher for both groups (82.5 percent for Early College students and 81.8 percent for comparison students), but these rates remained statistically indistinguishable.

Exhibit 2.7. Percentage of Students Enrolling in College After High School (Year 4), for All Cohorts, by Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
SOURCE: National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
* p < .05; ** p < .01; *** p < .001

We also examined rates of degree attainment after high school. Overall, Early College students had higher rates of degree attainment after Year 4: 7.8 percent of Early College students earned a postsecondary degree or credential, as compared with 4.7 percent of comparison students (see Exhibit 2.8).[17] This Early College impact held for bachelor's degrees: 4.5 percent of Early College students earned a bachelor's degree after Year 4, as compared with 1.2 percent of comparison students. However, the percentages of students earning associate's degrees after Year 4 were statistically indistinguishable (2.6 percent of Early College students and 2.0 percent of comparison students). This finding differs from our earlier report, which found that Early College students were more likely than comparison students to earn an associate's degree after Year 4.

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[17] As we did for college enrollment, we use Year 4 rather than high school graduation to take full advantage of available data. Analyses that used high school graduation date to define "after high school" produced degree attainment rates that were higher for both groups (14.6 percent for Early College students and 7.5 percent for comparison students); the difference between the groups was statistically significant.

Exhibit 2.8. Percentage of Students Who Earned Postsecondary Degrees After High School (Year 4), for All Cohorts, by Degree Type and Study Group

n = 2,458 students (1,044 Early College, 1,414 comparison)
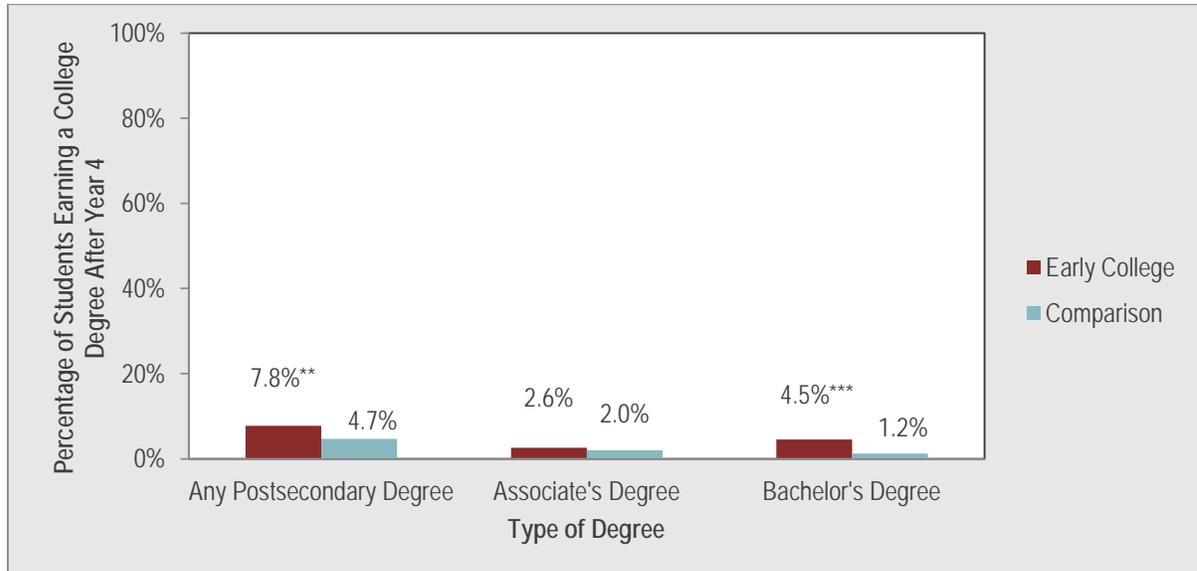*SOURCE:* National Student Clearinghouse, 2005–2013
NOTES: Early College means are unadjusted means, and comparison group means were computed by subtracting estimated treatment effects from the unadjusted Early College means.
* p < .05; ** p < .01; *** p < .001

What do these findings tell us about the impact of Early Colleges during and after high school? The results from this study suggest that the impact of Early Colleges occurred primarily during the high school years—it is in this timeframe that the magnitude of the group differences was the largest, and where enrollment and degree attainment results were consistently statistically significant. After high school, significant differences continued to exist in college degree attainment. The reader may be tempted to conclude from these findings that Early Colleges provide limited benefit after high school. However, the more appropriate interpretation may be that Early Colleges provided students with an edge over the comparison students during high school, and the edge persisted after high school. A complete understanding of how long the Early College impact persists would require tracking degree attainment over a more extended time period. This report contributes to that understanding by analyzing student outcomes for an additional year beyond those reported earlier (Berger et al., 2013); however, more study is required to understand any long-term impacts.

Conclusion

The additional data in this report affirm the core findings of the original study and indicate that the Early Colleges in our sample were highly effective at getting students on the path to a college degree.

We found that being admitted to an Early College had a significant positive impact on students' college enrollment and degree attainment. Early College students were more likely than comparison students to enroll in college overall. Because Early College students start college in high school, we should expect Early College students to complete college degrees earlier. However, Early College students were more likely to have earned college degrees at every point in time we examined.

We also examined whether the effects of Early Colleges differed for students with different background characteristics. We found that the effect of Early College on college enrollment did not differ for students with different characteristics. However, the effect of Early College on college degree attainment was stronger for minority, and low-income students, as well as students with higher levels of prior achievement relative to their peers.

After leaving high school, Early College students were more likely than comparison students to have earned a college degree. These persistent differences are likely due to the head start Early College students received while in high school. However, Early College students had about the same likelihood as comparison students of enrolling in college after high school, including attendance at both two-year and four-year institutions.

Our analyses suggest that the college enrollment and degree attainment differences between Early College and comparison students were largest by the end of the traditional high school experience (four years after entering ninth grade). These differences narrowed in later years, but statistically significant gaps remained on measures of whether students had ever enrolled. Students who enroll in college immediately after high school (i.e., by year 5) are more likely to complete a bachelor's degree (Adelman, 2006; Skomsvold et al., 2011). Therefore, these findings suggest that over time, the comparison students will not catch up with the treatment students in terms of bachelor's degree attainment. For the few years we examined, this holds true, as the comparison students have not caught up with the Early College students in earning a college degree of any type.

Although questions about the long-term impact of Early Colleges remain, the available evidence strongly indicates that Early College students complete college ahead of their comparison group peers. Even if comparison students were to catch up over time, Early Colleges offer the benefit of acceleration. Students who earn degrees earlier have the opportunity to enter the workforce earlier and potentially realize additional lifetime earnings.

At the same time, earning a college degree while in high school can save money for students and their families, as Early Colleges often cover most, if not all, of the college costs incurred during high school.

Continued study that considers outcomes for additional years beyond high school is required to determine whether long-term degree attainment and workforce outcomes are different between Early College and comparison students. Such research might help us understand whether Early Colleges act primarily as an accelerating mechanism, or whether they also produce higher degree attainment and job earnings for students over time.

References

Adelman, C. (2006). *The toolbox revisited: Paths to degree completion from high school through college.* Washington, DC: U.S. Department of Education. Retrieved from http://www2.ed.gov/rschstat/research/pubs/toolboxrevisit/toolbox.pdf

American Institutes for Research & SRI. (2009). *Early College High School Initiative evaluation synthesis report: Six years and counting: The ECHSI matures.* Washington, DC: American Institutes for Research.

Berger, A., Turk-Bicakci, L., Garet, M., Song, M., Knudson, J., Haxton, C., Zeiser, K., Hoshen, G., Ford, J., Stephan, J., Keating, K., & Cassidy, L. (2013). *Early college, early success: Early College High School Initiative Impact Study.* Washington, DC: American Institutes for Research. Retrieved from http://www.air.org/files/ECHSI_Impact_Study_Report_Final1.pdf

Bill & Melinda Gates Foundation. (2009). *College-Ready.* Retrieved from http://www.gatesfoundation.org/learning/Documents/College-ready-education-plan-brochure.pdf

Carnevale, A. P., Rose, S. J., & Cheah, B. (2011, August). *The college payoff: Education, occupations, lifetime earnings.* Washington, DC: Center on Education and the Workforce, Georgetown University. Retrieved from http://cew.georgetown.edu/collegepayoff/

Carnevale, A. P., Smith, N. Stone III, J. R., Kotamraju, P., Steuernagel, B., & Green, K. A. (2011, November). *Career clusters: Forecasting demand for high school through college jobs.* Washington, DC: Center on Education and the Workforce, Georgetown University. (Executive summary). Retrieved from http://cew.georgetown.edu/clusters/

Dynarski, S. M., Hemelt, S. W., & Hyman, J. M. (2013). *The missing manual: Using National Student Clearinghouse data to track postsecondary outcomes.* Cambridge, MA: National Bureau of Economic Research. Retrieved from http://www.nber.org/papers/w19552

Grusky, D. B., Bird, R. B., Rodriguez, N., & Wimer, C. (2013). *How much protection does a college degree afford? The impact of the recession on recent college graduates.* Washington, DC: The Pew Charitable Trusts.

Hedges, L. V. (1981). Distribution theory for Glass's estimator of effect size and related estimators. *Journal of Educational Statistics*, 6(2): 106–128.

Hoffman, N., & Webb, M. (2009, June). Early-college high school: Modest experiment or national movement? *Education Week, 28*(35). Retrieved from http://www.edweek.org/ew/articles/2009/06/11/35hoffman.html (login required).

 Horn, L., & Nuñez, A.-M. (2000). *Mapping the road to college: First-generation students' math track, planning strategies, and context of support* (http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2000153). U.S. Department of Education, National Center for Education Statistics. Washington, DC: U.S. Government Printing Office.

Jobs for the Future. (2008). *Early College High School Initiative Core Principles.* Boston: Author. Retrieved from http://www.earlycolleges.org/downloads/coreprincples.pdf

Jobs for the Future. (2013). *Early college high schools get results.* Boston, MA: Author. Retrieved from http://www.jff.org/sites/default/files/u3/ECHS_get_results_022513.pdf

Kleiner, B., & Lewis, L. (2005). *Dual enrollment of high school students at postsecondary institutions: 2002–03* (NCES 2005–008). Washington, DC: U.S. Department of Education, National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubs2005/2005008.pdf

Marken, S., Gray, L., & Lewis, L. (2013). *Dual enrollment programs and courses for high school students at postsecondary institutions: 2010–11* (NCES 2013-002). U.S. Department of Education. Washington, DC: National Center for Education Statistics. Retrieved from http://nces.ed.gov/pubsearch

NCES. (2012a). Actual and projected public school enrollment in grades prekindergarten (preK) through 12, by grade level and region: Selected school years, 1970–71 through 2021–22 [Table A-3-1]. *The condition of education 2012.* Washington, DC: U.S. Department of Education. Retrieved from http://nces.ed.gov/programs/coe/tables/table-enl-1.asp

NCES. (2012b). Characteristics of undergraduate institutions [Indicator 36-2012]. *The condition of education 2012* (NCES 2012-034). Retrieved from http://nces.ed.gov/pubs2012/2012045_4.pdf

NCES. (2012c). Graduation rates of first-time postsecondary students who started as full-time degree/certificate-seeking students, by sex, race/ethnicity, time to completion, and level and control of institution where student started: Selected cohort entry years, 1996 through 2007 [Table 345]. *Digest of education statistics 2011.* Washington, DC: U.S. Department of Education. Retrieved from http://nces.ed.gov/programs/digest/d11/tables/dt11_345.asp

National Student Clearinghouse. (2013). *About the Clearinghouse.* Retrieved from
http://www.studentclearinghouse.org/about/aboutus.htm

Skomsvold, P., Radford, A. W., & Berkner, L. (2011). Six-year attainment, persistence,
transfer, retention, and withdrawal rates of students who began postsecondary
education in 2003–04 (NCES 2011-152). Washington, DC: National Center for
Education Statistics, Institute of Education Sciences, U.S. Department of Education.
Retrieved from http://nces.ed.gov/pubsearch/pubsinfo.asp?pubid=2011152.

Thomas, N., Marken, S., Gray, L., & Lewis, L. (2013). *Dual credit and exam-based courses
in U.S. public high schools: 2010–11* (NCES 2013-001). U.S. Department of Education.
Washington, DC: National Center for Education Statistics. Retrieved from
http://nces.ed.gov/pubsearch.

Appendix A: Technical Details on Impact Analyses

Estimating the Impact of Being Offered Admission to an Early College (Research Question 1)

We used intent-to-treat (ITT) analyses to estimate the impact of being offered admission to an Early College through a lottery, regardless of whether the student actually enrolled in the Early College.[18] Defining students' treatment status on the basis of lottery results preserves the benefits of random assignment, maintaining the equivalence of the two study groups and thus ensuring the causal validity of the ITT impact estimates.

To take into account the clustering of students within lotteries, our impact analyses were based on a two-level model, where the intercept was modeled as a random effect to represent potential differences in average student outcomes across lotteries. For example, some lotteries may have attracted more-motivated or better-prepared students than others.

We estimated a common treatment effect across all lotteries (based on a fixed-effects approach) because the number of lotteries was too small to provide stable estimates of the variation in treatment effects across lotteries for some outcomes. The use of a common treatment effect means that the results should be generalized only to the set of Early Colleges in the sample.

Analyses of Variation in Early College Impact Across Students With Different Background Characteristics (Research Question 2)

This study's second research question asks whether the effect of being admitted to an Early College varies across students with different background characteristics. As noted in the first chapter, research has consistently found disparities in college degree attainment: minority, low-income, and first-generation college-going students are less likely on average to earn college degrees than their peers (NCES, 2012c). In fact, one of the guiding principles of the ECHSI is to serve these disadvantaged groups of students.

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[18] In the previous report, we also included complier analyses. The complier analysis estimates the impact of attending an Early College for students who attended due to winning the lottery. These complier and ITT impact estimates would be equivalent if all students complied with their treatment assignment—that is, if all students who won the lottery attended the Early College and no students who lost the lottery attended an Early College. The estimates may differ, however, if some lottery winners did not attend the Early College (i.e., no-shows) or if some who did not win the lottery enrolled in the Early College (i.e., crossovers).

We examined the potential differential effects of Early College on students with different background characteristics by incorporating treatment-by-student-characteristic interaction terms into the impact models. We explored whether the effects of being admitted to an Early College on key outcomes differed significantly by gender, race/ethnicity, first-generation college-going status, low-income status, or level of prior mathematics and ELA achievement.

For example, we measured the difference in Early College impact on college enrollment between minority and non-minority students by adding a treatment-by-minority interaction term to the student level of the main impact model. We performed similar analyses to test the potential differential effects of Early Colleges associated with gender, low-income status, first-generation college-going status, and prior ELA and mathematics achievement scores. These analyses were conducted for two key outcomes: college enrollment and college degree attainment.

The models for both research questions are described in further detail in the previous report in Appendix D.

Appendix B: Summary of Impact Findings

This appendix provides detailed ITT estimates for all outcomes examined in the overall impact analyses and differential impact analyses. Exhibit B.1 summarizes the results from the overall impact analyses and Exhibits B.2 and B.3 summarize the results from the analyses of differential Early College impact on enrolled in college, and earned a postsecondary degree. The tables include the percentage of Early College (EC) and comparison (C) students who experienced the outcomes, as well as effect sizes and p-values.[19]

Exhibit B.1. Summary of ITT Estimates of the Overall Early College Impact on College Binary Outcomes

Outcome	Analysis n	Effect in Logits	Odds Ratio	Std. Error (logit)	Probabilities		Effect Size	P-Value
					EC	C		
Enrolled in college	2,458	0.49	1.63	0.12	80.9%	72.2%	0.298	<.0001
Enrolled in college by Year 4	2,458	1.69	5.41	0.11	63.5%	24.3%	1.023	<.0001
Enrolled in college by Year 5	2,458	0.54	1.72	0.11	77.9%	67.2%	0.328	<.0001
Enrolled in college by Year 6	2,458	0.55	1.73	0.11	80.7%	70.7%	0.331	<.0001
Enrolled by Year 4 for 2005–06 and 2006–07 cohorts	1,458	1.65	5.21	0.15	61.7%	23.6%	1.001	<.0001
Enrolled by Year 5 for 2005–06 and 2006–07 cohorts	1,458	0.50	1.64	0.14	75.5%	65.3%	0.301	.0005
Enrolled by Year 6 for 2005–06 and 2006–07 cohorts	1,458	0.48	1.62	0.15	78.2%	68.8%	0.294	.0009
Enrolled by Year 7 for 2005–06 and 2006–07 cohorts	1,458	0.40	1.50	0.15	78.6%	71.0%	0.245	.0058

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[19] Effect sizes for binary variables are based on the following formula (Hedges, 1981): $\dfrac{X_1 - X_2}{\sqrt{\dfrac{(n_1-1)S_1^2 + (n_2-1)S_2^2}{(n_1+n_2-2)}}}$

Exhibit B.1. Summary of ITT Estimates of the Overall Early College Impact on College Binary Outcomes (cont.)

Outcome	Analysis n	Effect in Logits	Odds Ratio	Std. Error (logit)	Probabilities		Effect Size	P-Value
					EC	C		
Enrolled in a 2-year college	2,458	0.84	2.33	0.11	60.8%	40.0%	0.512	<.0001
Enrolled in a 2-year college by Year 4	2,458	1.92	6.82	0.13	48.3%	12.0%	1.164	<.0001
Enrolled in a 2-year college by Year 5	2,458	1.05	2.85	0.11	55.8%	30.7%	0.635	<.0001
Enrolled in a 2-year college by Year 6	2,458	0.90	2.46	0.11	60.0%	37.8%	0.546	<.0001
Enrolled in a 4-year college	2,458	0.17	1.19	0.10	54.4%	50.1%	0.105	.0965
Enrolled in a 4-year college by Year 4	2,458	1.07	2.92	0.16	25.2%	10.4%	0.649	<.0001
Enrolled in a 4-year college by Year 5	2,458	0.21	1.23	0.11	49.1%	44.0%	0.126	.0526
Enrolled in a 4-year college by Year 6	2,458	0.28	1.32	0.10	53.3%	46.3%	0.169	.0081
Earned any postsecondary degree	2,458	1.90	6.71	0.17	24.9%	4.7%	1.153	<.0001
Earned a certificate	2,458	0.12	1.13	0.42	1.3%	1.2%	0.076	.7656
Earned an A.A. degree	2,458	2.50	12.14	0.21	22.7%	2.4%	1.513	<.0001
Earned a B.A. degree	2,458	1.34	3.80	0.33	4.5%	1.2%	0.810	<.0001
Postsecondary degree earned by Year 4	2,458	3.57	35.37	0.33	20.9%	0.7%	2.161	<.0001
Postsecondary degree earned by Year 5	2,458	3.06	21.38	0.26	22.4%	1.3%	1.856	<.0001
Postsecondary degree earned by Year 6	2,458	2.69	14.66	0.22	23.7%	2.1%	1.627	<.0001
Postsecondary degree earned by Year 4 for 2005–06 and 2006–07 cohorts	1,458	4.07	58.42	0.57	17.7%	0.4%	2.465	<.0001

Exhibit B.1. Summary of ITT Estimates of the Overall Early College Impact on College Binary Outcomes (cont.)

Outcome	Analysis *n*	Effect in Logits	Odds Ratio	Std. Error (logit)	Probabilities		Effect Size	P-Value
					EC	C		
Postsecondary degree earned by Year 5 for 2005–06 and 2006–07 cohorts	1,458	2.98	19.71	0.35	19.5%	1.2%	1.807	<.0001
Postsecondary degree earned by Year 6 for 2005–06 and 2006–07 cohorts	1,458	2.52	12.46	0.30	20.2%	2.0%	1.529	<.0001
Postsecondary degree earned by Year 7 for 2005–06 and 2006–07 cohorts	1,458	1.72	5.59	0.22	22.2%	4.8%	1.043	<.0001
Enrolled in any college after high school	2,458	0.13	1.14	0.11	73.1%	70.5%	0.078	.2292
Enrolled at any college after high school graduation date	1,791	0.05	1.05	0.14	82.5%	81.8%	0.030	.7267
Enrolled in 2-year college after high school	2,458	-0.06	0.94	0.10	35.7%	37.2%	-0.038	.5302
Enrolled in 4-year college after high school	2,458	0.14	1.16	0.10	52.4%	48.8%	0.088	.1607
Earned any type of postsecondary degree after high school	2,458	0.54	1.71	0.21	7.8%	4.7%	0.325	.0091
Earned any type of postsecondary degree after high school graduation date	1,791	0.74	2.09	0.19	14.6%	7.5%	0.446	.0001
Earned A.A. degree after high school	2,458	0.27	1.31	0.32	2.6%	2.0%	0.166	.3884
Earned B.A. degree after high school	2,458	1.34	3.80	0.33	4.5%	1.2%	0.810	<.0001

NOTES: The treatment group probabilities are unadjusted probabilities; the comparison group probabilities were computed based on the unadjusted treatment group probabilities and estimated Early College effects.

Exhibit B.2. Differential Early College Impact on Enrolled in College and Any Postsecondary Degree, by Student Background Characteristics

Student Characteristics	X = 1 (Probability)				X = 0 (Probability)				Differential Effect		
	EC	C	Difference	N	EC	C	Difference	N	Odds Ratio	Difference in Effect	P-Value
Enrolled in College											
Female	82.1%	77.4%	4.7%	1,264	79.7%	66.5%	13.3%	1,194	0.7	-8.6%	.0839
Minority	81.0%	74.3%	6.7%	965	84.8%	74.0%	10.7%	856	0.8	-4.0%	.2842
Low income	76.3%	66.7%	9.6%	1,266	85.7%	76.4%	9.3%	1,130	0.9	0.3%	.5967
First generation	74.8%	70.2%	4.6%	958	83.6%	73.2%	10.4%	1,508	0.7	-5.8%	.2466
Earned Any Postsecondary Degree											
Female	27.0%	5.2%	21.8%	1,264	22.7%	4.2%	18.4%	1,194	1.0	3.4%	.9696
Minority	29.4%	3.0%	26.4%	965	25.8%	6.5%	19.2%	856	2.7	7.2%	.0059
Low income	22.1%	2.6%	19.5%	1,266	27.6%	7.2%	20.3%	1,130	2.2	-0.8%	.0245
First generation	23.7%	4.0%	19.8%	958	25.3%	5.0%	20.4%	1,508	1.2	-0.6%	.7463

NOTES: X = 1 for female, minority, low income, first generation; X = 0 for male, non-minority, not low income, not first generation. The treatment group probabilities within a given student subgroup are unadjusted probabilities; the comparison group probabilities were computed based on the unadjusted treatment group probabilities and estimated Early College effects within the subgroup. The values in the Difference columns may not match the difference between the Early College and Comparison group means due to rounding. To analyze differential effects for minority and non-minority students, two lotteries were removed from analyses because zero Early College students were non-minority, and thus Early College impacts among non-minority students could not be estimated within these lotteries. Similarly, one lottery was removed from analyses of differential Early College effects among low-income students because zero students within this lottery were low-income.

Exhibit B.3. Differential Early College Impact on Enrolled in College and Any Postsecondary Degree, by Prior Achievement

Prior Achievement	X = -1 Standard Deviation (Probability)			X = 0 Standard Deviation (Probability)			X = +1 Standard Deviation (Probability)			Differential Effect		
	EC	C	Difference	EC	C	Difference	EC	C	Difference	Odds Ratio	N	P-Value
Enrolled in College												
ELA	73.8%	65.8%	8.0%	80.2%	70.7%	9.5%	85.3%	75.1%	10.2%	1.2	2,458	.246
Mathematics	72.6%	61.2%	11.4%	80.0%	70.7%	9.2%	85.7%	79.0%	6.7%	1.0	2,458	.835
Earned Any Postsecondary Degree												
ELA	8.0%	1.4%	6.6%	9.3%	0.9%	7.9%	10.7%	0.6%	10.1%	1.8	2,458	.037
Mathematics	5.1%	1.0%	4.1%	9.3%	1.0%	7.8%	16.3%	1.0%	15.3%	1.9	2,458	.002

NOTES: The treatment group probabilities for a given level of prior achievement (i.e., 1 SD below the state average, state average, and 1 SD above the state average) are predicted probabilities when all control variables other than the prior achievement measure were set to their grand means. The comparison group probabilities were computed based on the predicted treatment group probabilities and the estimated differential Early College effects. The values in the Difference columns may not match the difference between the Early College and Comparison group means due to rounding.

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