Annenberg Institute
BROWN UNIVERSITY

EdWorkingPaper No. 25-1136

The Costs and Benefits of North Carolina's Early College High School Model

Brian Phillips
RAND

Julie A. Edmunds
UNC-Greensboro

Fatih Unlu
Amazon

Elizabeth Glennie
RTI International

Christine Mulhern
RAND

Early colleges are high schools that blend the high school and college experiences. They have been shown to increase college enrollment and completion; however less is known about the costs of the early college model relative to traditional high schools. We leverage randomized assignment of North Carolina students to early colleges to estimate the costs, benefits, and net benefits (benefits minus costs) to society of individuals earning credentials via the early college model relative to the traditional high school route. The societal costs for each student earning an associate or bachelor's degree are roughly $10,000 less per student for students in the early college model, largely attributable to these students earning more college credits at less expensive institutions while in high school and fewer credits at more expensive institutions after high school. Because early college students are more likely to earn a postsecondary credential, the average societal costs of education across all students in our sample were roughly the same for early college and traditional high school students, and the higher level of educational attainment on average for early college students resulted in larger net benefits for the early college model of nearly $16,000 per student. We found larger net benefits for first generation and economically disadvantaged students than their counterparts not in those subgroups.

VERSION: February 2025

Suggested citation: Phillips, Brian, Julie A. Edmunds, Fatih Unlu, Elizabeth Glennie, and Christine Mulhern. (2025). The Costs and Benefits of North Carolina's Early College High School Model. (EdWorkingPaper: 25 -1136). Retrieved from Annenberg Institute at Brown University: https://doi.org/10.26300/xsfk-v782

The Costs and Benefits of North Carolina's Early College High School Model

Brian Phillips, RAND
Julie A. Edmunds, Early College Research Center at SERVE, UNC-Greensboro
Fatih Unlu, Amazon[1]
Elizabeth Glennie, RTI International
Christine Mulhern, RAND

January 2025[2]

Abstract

Early colleges are high schools that blend the high school and college experiences. They have been shown to increase college enrollment and completion; however less is known about the costs of the early college model relative to traditional high schools. We leverage randomized assignment of North Carolina students to early colleges to estimate the costs, benefits, and net benefits (benefits minus costs) to society of individuals earning credentials via the early college model relative to the traditional high school route. The societal costs for each student earning an associate or bachelor's degree are roughly $10,000 less per student for students in the early college model, largely attributable to these students earning more college credits at less expensive institutions while in high school and fewer credits at more expensive institutions after high school. Because early college students are more likely to earn a postsecondary credential, the average societal costs of education across all students in our sample were roughly the same for early college and traditional high school students, and the higher level of educational attainment on average for early college students resulted in larger net benefits for the early college model of nearly $16,000 per student. We found larger net benefits for first generation and economically disadvantaged students than their counterparts not in those subgroups.

[1] This paper includes work done by Fatih Unlu during his employment at RAND, prior to starting at Amazon.

[2] The research reported here was supported by the Institute of Education Sciences, U.S. Department of Education, through Grants R305R060022, R305A110085, R305A140361, and R305H190036 and by a grant from Arnold Ventures to the University of North Carolina at Greensboro. The views expressed are those of the authors and do not represent the views of the Institute of Education Sciences, the U.S. Department of Education, or Arnold Ventures.

Introduction

Early colleges are high schools that blend the high school and college experiences. As implemented in North Carolina, they are small schools of choice located on college campuses, with a focus on enrolling students in groups traditionally underrepresented in college. They offer students the opportunity to earn a high school diploma and an associate degree or two years of college credit within the four or five years they are in high school. Experimental analyses of the early college model have found that it increases enrollment in postsecondary education and attainment of postsecondary credentials (Atchison et al., 2021; Edmunds et al., 2024; Edmunds et al., 2020; Edmunds et al., 2017; Song & Zeiser, 2021). Moreover, early college students who go on to earn degrees receive those degrees earlier, on average, than students who attend traditional high schools (Edmunds et al., 2024; Edmunds et. al., 2020; Song & Zeiser, 2021).

Despite these encouraging findings, there is limited evidence on the cost and cost-effectiveness of the early college model relative to the traditional high school model. Atchison et al. (2021) found that the increased educational attainment associated with attending early colleges yields lifetime benefits that exceed the higher costs of the model by about $54,000. When focusing only on benefits accruing to the public (e.g., via higher tax revenues or reduced social spending), benefits exceed costs (borne by the public) by about $20,000 (Atchison et al., 2021). Those analyses included the costs of postsecondary instruction while in high school, but they did not account for differences in the costs of postsecondary enrollments after high school that may have been shaped by the early college experience. The analyses in this paper expand upon that work to consider the costs and benefits of the early college model when including costs of students' educational experiences in high school and within six years after. We also leverage a larger sample that permits exploration of differential impacts on subgroups of students.

We consider the following three research questions:

1. What is the average cost to society for individuals earning a four-year degree, a two-year degree, and a high school diploma when students take the early college model route compared with the traditional high school route? What is the average cost borne by the students themselves of earning four- and two-year degrees through the two routes?
2. What are the average costs and benefits to society of the early college model? To what extent is there a net societal benefit from the early college model?
3. To what extent do impacts on net societal benefits differ by characteristics such as race/ethnicity, economically disadvantaged status, and first generation in college status?

Conceptual Framework

Early colleges are an innovative model of schooling that combines aspects of the high school and college experiences. Nationally, there were more than 1,200 early colleges as of December 2024, which include stand-alone schools as well as programs within traditional high schools (American Institutes for Research, undated). In North Carolina, early colleges are small stand-alone schools frequently located on college campuses. They serve students in grades nine to twelve, with some offering a fifth year of high school as part of the standard program of study. By law, they have a primary focus on recruiting and serving students who are underrepresented in college, including first generation students, students who are at risk of dropping out, and economically disadvantaged students. Each early college is expected to implement and exhibit a specific set of practices that provide a comprehensive experience focused on helping all students take and succeed in college courses. This includes a curriculum focused on college courses so that students can earn their high school diploma and an associate degree or two years of transferrable college credit within four or five years. Early colleges also focus on fostering a

college-going culture, with advisors and counselors helping students prepare for their future careers and providing support in applying to college and completing financial aid applications. The schools also provide extensive academic and affective supports to help students succeed in this more challenging model.

We anticipate that the early college model might have different costs and benefits than the regular high school experience. In this section, we describe—at a theoretical level—the features of the early college that might result in differences in costs and benefits. In the methodology section, we describe how we operationalized costs and benefits in more detail. Our primary analyses focus on costs, benefits, and net benefits (benefits minus costs) *to society* of the early college and traditional high school models—to shed light on whether anticipated benefits to the public (e.g., via higher tax revenues and reduced social spending) offset expenditures on education (e.g., by federal, state, and local governments, as well as by individuals). Any private benefits that accrue to individuals via higher lifetime earnings are not included in our analysis.

Costs for the Early College

The model that we are studying is a stand-alone school that is supported by both the secondary and postsecondary sectors, which has implications for the costs of the model and who bears them. The high school district provides resources to support high school teachers and administrative staff (e.g., a principal, a counselor, and office staff). On the one hand, early colleges are small schools with a maximum size of 400 students, which could lead to higher per-student costs because small schools are often not able to benefit from the economies of scale that larger schools enjoy (Lawrence et al., 2002). In addition, early colleges often have a district-funded college liaison, who negotiates the relationship between the high school and host college, adding to the costs of the model. But there could be savings to the district as well. Only about

half of students' courses are taught by high school teachers, so there are usually fewer high school teachers per student in these schools than in regular high schools. These schools generally offer fewer extracurriculars (e.g., band, sports, arts) or elective courses that require additional staff (Cuellar & Allen, 2024). Additionally, early colleges serve fewer students with special needs so have fewer costs associated with those services. Depending on how these competing factors balance out, it is possible that the district expenditures associated with the early college might be less than the costs for a regular high school.

However, the district costs represent only a portion of the costs of an early college. The early college also receives a substantial amount of support from the college with which it is associated. For almost all North Carolina early colleges, the college provides the physical space and maintenance for the early college. Students can earn a large portion of their high school credits as dual credit by taking regular college courses offered on the college campus, with direct costs to the college of this coursetaking reimbursed by the state in accordance with the state's dual enrollment program financing model. College administrators spend a portion of their time on issues related to the early college, and students have access to college resources such as the library and tutoring centers. Students often participate in other activities offered by the college. These costs are likely similar to the costs incurred by traditional college students, although there are other costs (mostly related to housing and board) that early college students would not incur.

As this brief description suggests, any consideration of the costs of the early college needs to include both costs incurred by secondary and postsecondary institutions. Looking only at high school district or postsecondary institution costs would present a partial picture.

Benefits from the Early College

Like the costs, the benefits reflect positive impacts that result from both secondary and postsecondary experiences. First, the early college model has a positive impact on high school graduation rates (Berger et al., 2013; Edmunds et al., 2017), and students who graduate from high school have far better life outcomes than those who drop out (Carroll & Erkut, 2009). Early college students are also more likely to enroll in postsecondary education, particularly in two-year colleges (Berger et al., 2013; Edmunds et al., 2017). Recent research suggests that simply enrolling in college, even if no credential is earned, has benefits associated with it, including increased employment and earnings (Giani, Attewell, & Walling, 2020).

Research also has shown that early college students are much more likely to receive an associate degree, with impacts of about 20 percentage points (Edmunds et al., 2024; Song & Zeiser, 2021). The impact on earning both an associate and a bachelor's degree was more than 10 percentage points (Edmunds et al., 2024). There was no significant impact on overall bachelor's degree attainment, although there was evidence that early college students completed their degrees (both associate and bachelor's) more rapidly (Edmunds et al., 2024; Edmunds et al., 2020), which could yield lower total costs to society and to students themselves.

In general, research agrees that there are positive returns overall to college (Hout, 2012), although there are differences by type of credential and field of study (Bahr et al., 2015; Zhang, Liu, & Hu, 2024). The research is less clear about the benefits of community college degrees, with some researchers finding positive returns to associate degrees (Jepsen, Troske, & Coomes, 2014) and others finding positive returns primarily for technical credentials in high-yield fields (Carnevale, Garcia, Ridley, & Quinn, 2020), although results can differ by population and type of credential (Dagdar & Trimble, 2015).

On balance, the estimates of positive impacts on postsecondary credential attainment suggest that the early college model is likely to lead to long-term benefits and that it would be useful to conduct cost-benefit analyses. The impact analysis findings also have implications for how we think about looking at costs and benefits together, as we discuss in the next section.

Looking at Costs and Benefits Together

Because early colleges combine aspects of the high school and college experiences, as described above, we need to consider the costs associated with both the secondary and postsecondary sectors. Similarly, we need to consider the benefits that are coming from both high school and postsecondary outcomes. While we can calculate both in a regularly straightforward way for the early college students, the cross-sector structure makes it challenging to identify an appropriate comparison condition.

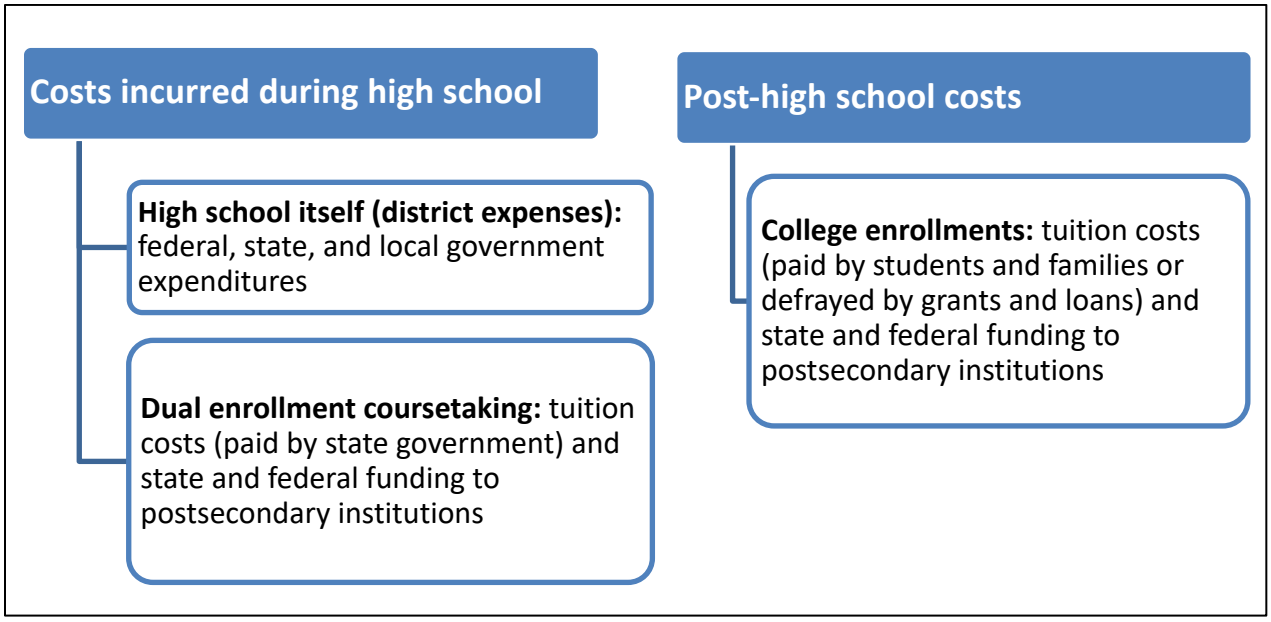
A traditional approach would compare the costs of a high school intervention to the costs of what would occur at the high school in the absence of that intervention. In our context, examining the costs for early college students means combining costs incurred by the high school districts with costs incurred by colleges to deliver the early college model to high schoolers. Traditional high school students, by contrast, typically would only result in spending by the districts. However, because the early college model can accelerate the pathway to a credential, we believe that many of the costs of postsecondary education incurred by early college students while they are still in high school are costs that are accrued by the comparison group after they leave high school and enroll in postsecondary education. Only looking at students' high school years, therefore, could give a misleading and inflated impression of the costs of the early college model relative to the comparison. To address this concern, we looked at the total costs incurred from ninth grade through postsecondary education in the early college

model and compared it to the costs from ninth grade through postsecondary education for students who were in a traditional public high school. This approach recognizes that in the early college model, some college costs will occur in high school while many of these costs will still be incurred in the comparison group, just at a later point in time.

Our cost comparison also is affected by the fact that students in the early college are more likely to enroll in postsecondary education and receive degrees. As a result, we anticipated that the full costs of education for the early college population might be higher than the costs for our comparison group simply because the intervention is effective at increasing students' level of engagement with postsecondary education. To account for this, we compared costs looking only at students who completed three different sets of credentials in our treatment and comparison groups: a high school diploma, an associate degree, and a bachelor's degree. This approach enabled us to estimate how the cost to earning a given credential, e.g., a bachelor's degree, varies based on whether a student attended an early college.

Another challenge is that the early college model may shift costs from one party to another. When students take college courses in high school, state funding pays for the courses; however, when students take college courses after high school, they either pay for them out of pocket or receive federal, state, or institution-funded financial aid to offset costs. Thus, there likely are differences between our treatment and comparison groups in who is covering the costs of the educational experiences. For most analyses in this study, we avoid this complexity and consider the costs to society regardless of whether the student or local, state, or federal governments are paying those costs. Figure 1 presents—for each category of costs to society—who we anticipate bears those costs.

Figure 1. Who Bears Costs to Society of Education, by Timing and Type of Costs



Considering the cost to society is a valid perspective to use when examining costs (Institute of Education Sciences, 2020). We also use this perspective to consider the benefits to society instead of looking just at the benefits individuals would receive (e.g., via higher lifetime incomes). However, we recognize that there is interest in understanding the extent to which the costs for families themselves are affected by the model. Therefore, we provide separate estimates of the overall expected costs paid by students and families.

The next section describes how we calculated costs and benefits.

Methods

Our analysis builds on a lottery-based experimental study of students who applied to early colleges in North Carolina starting in the mid-2000s. Applicants who were randomly accepted to the early college form the treatment group. The control group consists of those who applied and were not randomly accepted.

Sample and Data

In total, 4,073 students participated in the lotteries across six cohorts. The first cohort entered ninth grade in 2005-06 and the final cohort entered ninth grade in 2010-11. The sample included a total of 2,345 treatment and 1,728 control students who applied to 19 early colleges. More detail on the original study design can be found in Edmunds et al. (2024).

We linked students' early college application data to longitudinal administrative data on K-12 and postsecondary education, matched on name and birthdate by the North Carolina Education Research Data Center (NCERDC). Student-level data on high school and middle school experiences came from the North Carolina Department of Public Instruction (NCDPI) via NCERDC. These data included a rich array of demographic (e.g., race/ethnicity), socioeconomic (e.g., economically disadvantaged status), and achievement (e.g., state end-of-grade exam scores) variables measured prior to student enrollment in an early college or traditional high school. Individual-level postsecondary data came from the North Carolina Community College System (NCCCS), the University of North Carolina (UNC) System, and the National Student Clearinghouse (NSC). The NCCCS and UNC System data included information on enrollments, coursetaking, and completions at North Carolina public postsecondary institutions. The NSC data included enrollment and completion data for public and private institutions nationwide.

High school cost data capturing state expenditures came from NCDPI. We used school-level NCDPI cost data for the 2011-12 school year, which represented a year in the middle of when students in our sample were in high school. We used school-level data inclusive of local and federal expenditures from the National Education Research Database on Schools (NERD$) to scale up the state expenditures, using the state-to-total-expenditures ratio only (rather than the costs themselves) since these data were unavailable for the years when study students were in

high school (Edunomics Lab, 2022). Our postsecondary cost data came from the Integrated Postsecondary Education Data System (IPEDS). We used a subset of cost categories (described below) to estimate costs to society of providing the education. We also used IPEDS (average net price) data to estimate the portion of costs borne by students and their families. In both cases, we used 2018-19 IPEDS data. We inflated both high school and postsecondary costs to 2020 dollars.

Our samples varied by research question. Research Question 1 is descriptive in nature and looks at costs of earning a credential through the early college and traditional high school models: a high school diploma (overall and for those who do not earn a degree), an associate degree, and a bachelor's degree. Only students who attained these credentials were included in the analysis. Our main analysis included students earning degrees from any institution in the NSC data, using NSC data on enrollment intensity to proxy the post-high school societal costs of postsecondary enrollments. We also considered costs borne by students and their families of earning two- and four-year degrees through the early college and traditional high school pathways, relying on IPEDS net price data to estimate costs of post-high school enrollments. Because student and family expenditures offset a portion of institutional expenditures (considered in the societal costs analysis), we did not add these expenditures to the total societal costs estimate; rather, we separately considered costs borne by students and families.

Research Question 2 utilizes the experimental contrast to look at all costs associated with the early college model and students' postsecondary education (regardless of whether students earned a credential) and estimates of the financial benefits to society of different levels of educational attainment. The sample included 3,510 students (2,068 treatment and 1,442 control students) with non-missing data for key measures needed for the analysis, namely, confirmation that they attended NC public schools through high school graduation (or until they dropped out).

Students who left (or never entered) North Carolina public high schools were considered attritors from the sample. The overall attrition rate was 13.8 percent, 11.8 percent for the treatment group and 16.6 percent for the control group, with a differential attrition rate of 4.7 percentage points. These attrition rates qualify as low attrition under cautious assumptions according to What Works Clearinghouse (WWC) standards (U.S. Department of Education, 2022). We assessed all outcomes as of ten years after entering ninth grade (typically six years after leaving twelfth grade), which was the 2019-20 school year for the sixth and final cohort in our study.

Measures

High school and college costs were both calculated using administrative data on expenditures. Table 1 summarizes the sources and methods for each category of costs.

High School Costs Provided by the District

Because early colleges are stand-alone schools, we could calculate costs using school-level per-pupil expenditures data. We started with detailed school-level data on state expenditures from 2011-12, broken out by purpose and object code, provided to us by NCDPI. We used NCDPI guidance around which expenditure categories to include when calculating per-pupil expenditures (e.g., excluding capital expenditures that can vary widely from year to year) (NCDPI, 2021); however, we excluded some cost categories that we viewed as likely to bias estimates in favor of the early colleges. Excluded categories included expenditures for special education and English language learners, since early colleges serve relatively few students in these groups, as well as for nutrition services.

The detailed budget expenditures only included state allocations and not local or federal allocations. To account for these allocations in our estimates, we used school-level data from NERD$, from the first year those data were available (2018-19) (Edunomics Lab, 2022). We did

Table 1. Summary of Sources and Methods for Estimation of Costs to Society of Education, by Timing and Type of Costs

Timing of Cost	Type of Cost	Sources	Methods
During HS	High School Education (district expenses)	NCDPI state expenditure data (2011-12); NERD$ expenditure data including state, federal and local expenditures (2018-19); NCERDC data on student's HS enrollments by year	Sum state expenditures by school; [a] Use ratio of state to total spending from NERD$ to scale expenses to reflect total school-level costs; Construct per-pupil measure for each school by dividing by enrollment (in 2011-12); Sum per-pupil measures for student's schools for the years the student was enrolled in high school
During HS	Dual enrollment coursetaking	IPEDS institutional expenditures data (2018-19); NCCCS and UNC System data on credits attempted while in HS	Sum core expenses from IPEDS for instruction, academic support, institutional support, and student services; Calculate each institution's costs per FTE based on 32 credits per FTE; [b] Sum costs for dual enrollment coursetaking based on the number of credits attempted (portion of FTE) at each institution while in high school
Post HS	College enrollments	IPEDS institutional expenditures data (2018-19); NSC data on student enrollments	Use costs-per-FTE data (calculated as described in the row above) and sum costs of college enrollments using NSC data on full- or part-time enrollment status to proxy the portion of an FTE for each student at each institution

NOTES: NCDPI = North Carolina Department of Public Instruction. NERD$ = National Education Research Database on Schools. NCERDC = North Carolina Education Research Data Center. NCCCS = North Carolina Community College System. UNC = University of North Carolina. IPEDS = Integrated Postsecondary Education Data System. FTE = full-time-equivalent. NSC = National Student Clearinghouse.

[a] We used NCDPI guidance on which expenditure categories to include when calculating per-pupil expenditures (NCDPI, 2021); however, we excluded some cost categories that we viewed as likely to bias estimates in favor of the early colleges. Excluded categories included expenditures for special education, disabled, English language learners, since early colleges serve relatively few students in these groups, as well as nutrition services.

[b] We drew upon NCCCS-provided data on the ratio of credit to total students to determine the cost-per-FTE for community colleges, because IPEDS FTE calculations include students in for-credit programs only in the denominator, although the numerator—costs—includes expenditures on noncredit students.

[c] For a sensitivity analysis, we restricted to NCCCS and UNC System enrollments only and used the same method as for dual enrollment coursetaking to estimate post HS costs of enrollments.

not use actual spending amounts given that the data did not cover the period when early college students were in high school. Rather, we estimated the amount of federal and local funding for each school by identifying the share of all expenditures (state, federal, and local) that came from state sources (e.g., two-thirds) and then multiplied the estimated state expenditures for each high school (from the detailed school-level data) by the multiplicative inverse of the state share of total expenditures in the NERD$ data (e.g., by 1.5 in this example) to derive the total estimated school expenditures from state, federal, and local funding sources.

We converted these school-level total amounts to costs per student by dividing the totals by enrollment in the 2011-12 data. We then summed the yearly per-pupil costs for the high schools the students attended from ninth grade until high school graduation (or dropout) to derive a value for high school costs provided by the district for each student.

High School Costs Provided by the College

The early college costs borne by the colleges—courses, facilities, administration, support services—are not reflected in the NCDPI expenditure data. To account for these costs, we developed a proxy measure based on IPEDS data on college expenses and information on the number of credits students took. We began by calculating credits attempted in high school at NCCCS and UNC System schools and converting credits as a proportion of full-time-equivalent (FTE) enrollment based on 32 credits per FTE. We calculated costs using core expenses from IPEDS for instruction, academic support, institutional support, and student services (2018-19 data), and divided that by the institution's FTE enrollment in that same year. For four-year institutions, we used the FTE enrollment noted in IPEDS. For community colleges, we received institution-level data from NCCCS with total FTE enrollment including curriculum (credit) and

noncredit students.[3] We used the same approach to calculate costs for any dual enrollment courses our control students took. Each student then received a value based on the number of courses they took in high school and the institution where they took the courses.

College Costs Post-High School

We calculated the costs of postsecondary enrollments after high school in two ways. For our primary analysis, we used the same institution-level cost-per-FTE measures described above but used NSC data (instead of actual credits attempted) to estimate the portion of an FTE enrollment for each student at each institution. This allowed us to estimate costs for students who attended any postsecondary institution, rather than just those at North Carolina institutions. We assigned FTE based on the number of months a student was enrolled.[4] To adjust the FTE for community colleges, we applied a proportional adjustment to FTE enrollment for out-of-state institutions that reflected the average ratio we applied for in-state institutions (about 1.4 to 1).

Additionally, for sensitivity analyses, we calculated costs of postsecondary enrollments after high school using the same credit-based accounting approach as for dual enrollment coursetaking (see above) for students who earned degrees from NCCCS or UNC System institutions. This allowed us to compare our estimates using the NSC-based method of proxying costs to a credit-based method. This also allowed us to unpack how variation in patterns of credit-earning affects costs. Note that these sensitivity analyses restricted NSC-based costs to those incurred at North Carolina public institutions to enable a more direct comparison.

[3] We used these FTE numbers in lieu of IPEDS FTE enrollment because IPEDS FTE calculations includes students in for-credit programs only, although the numerator—costs—includes expenditures on noncredit students.

[4] For full-time enrollments, we assign 0.25 FTE for 0-3 months enrolled, 0.5 FTE for 4-6 months, 0.75 FTE for 7-9 months, and 1.0 FTE for 10-12 months. We halve these amounts for part-time enrollments and multiply them by 0.75 when enrollment status is unknown.

Costs to Students and Families

In looking at the costs for students and families, we focused only on the expected costs for post-high school college enrollments, assuming that students and parents did not pay additional costs the high school level. These expenditures partially offset institutional costs and as such cannot simply be added to our total societal cost estimates above. To estimate private costs to students and families, we used IPEDS data (again from 2018-19) on the average net price to students awarded grant or scholarship aid from federal, state, or local governments, or the institution. These data are based on financial aid data for first-time degree/certificate-seeking undergraduates paying the in-state tuition rate (at public institutions) and are inclusive of estimates of costs for tuition and fees, room and board, and books and supplies. We used an identical approach as our cost to society estimates to convert these net price data to estimated costs for students' post-high school college enrollments, swapping in the average net price for the institution-level cost-per-FTE measure. Again, our primary analyses used NSC intensity of enrollment data to proxy costs, while a sensitivity analysis considered costs using this method and a credit-based accounting for students who earned degrees from North Carolina public colleges. We included post-high school costs of postsecondary education only in these estimates.

Total Costs to Society

We derived the total societal cost for each student in our analysis by adding district-level expenditures, expenditures associated with college courses taken in high school, and the institutional expenditures of any postsecondary enrollments based on a students' actual experiences. We looked at costs to society in two different ways: 1) the cost to obtaining a credential; and 2) the total educational cost through six years post high school regardless of whether students earned a postsecondary credential. We calculated our costs to society based on

institutional expenditures, which are covered by a mix of taxpayer dollars and private expenditures by families and students. To supplement these estimates, we separately estimated the direct costs borne by students and their families to obtain a two- and four-year degree.

Importantly, note that we did not apply any discount factors to account for the fact that early college students incurred some postsecondary costs in earlier time periods (e.g., in high school) than members of the comparison group (e.g., in later years in college). We expect that offsetting factors could make costs incurred in earlier time periods more or less expensive than those incurred later. On the one hand, time value of money suggests that future costs should be discounted to present value (Shand & Bowden, 2021). On the other, growth in institutional expenses per FTE student outpaced general price inflation over the decade ending in 2019-20 at both public and private institutions (National Center for Education Statistics, 2022), suggesting that tuition and other higher education costs incurred in earlier years would be lower than those in later periods. Some researchers have accounted for both factors in their cost analyses (Washington Institute for Public Policy, 2023). However, for simplicity, we assumed that the competing factors offset, and did not incorporate a discount factor or time-varying inflation rates. Rather, we inflated all costs, no matter when they occurred in calendar time or time relative to students' entry into high school, to 2020 dollars using the Consumer Price Index.

Benefits

We used estimates from Carroll and Erkut (2009) of the benefits to society of different levels of educational attainment. They estimated the effects of increasing educational attainment on tax revenues, program expenditures, and revenues for social support and insurance programs, and spending on incarceration. They examined effects relative to dropping out of high school for educational attainment from high school graduate to four-year college graduate. They did so

separately by gender and race or ethnicity, reporting estimates for males and females for Hispanic and non-Hispanic white, Black, and Asian individuals. We note that their estimates are used as the "conservative" estimates of public benefits in other research on the costs and benefits of early colleges (Atchison et al., 2021). We assigned each student to one of five benefit categories based on their educational attainment by six years after twelfth grade: high school dropout (no college), high school dropout (some college), high school graduate (no college), high school graduate (some college), and four-year college graduate. Carroll and Erkut (2009) did not separately estimate benefits to associate degrees; we included those whose highest degree was an associate degree in our "some college" groups. For American Indian and multiracial students (less than 5 percent of the analytic sample), we assumed benefits equal to the average benefits (by gender) for the racial and ethnic groups underrepresented in college for which Carroll and Erkut (2009) provided estimates (Hispanic and non-Hispanic Black students), rather than dropping them from the sample or making more specific assumptions for each of those groups.

Analytic Approach

Our analytic approach varied depending on the research question.

Cost to Credential

For Research Question 1, we sought to understand whether the early college route was a more or less expensive way to earn a postsecondary credential. As a result, we looked descriptively at the costs to attain three different credentials—high school diploma, associate degree, and bachelor's degree. For the cost to a high school credential, we looked at the costs (calculated as described above) for each student who received a high school diploma, stopping at the point at which students earned that diploma. For associate and bachelor's degrees, we looked at all costs to the point at which the student earned the degree. We weighted the descriptive

estimates using inverse probability weights based on the probability of each student's selection into the early college.[5]

Costs and Benefits

Research Question 2 addresses the relationship between total costs and benefits for early college and comparison students. Unlike Research Question 1, we used the entire sample of students regardless of whether they attained a credential. We created student-level measures of the cost of high school and the cost of college courses taken in high school as described above. We exclusively used the NSC-based method of estimating costs of postsecondary enrollments after high school, which allowed us to keep the experimental contrast intact. We summed costs across two- and four-year institutions attended through six years after twelfth grade or receipt of a four-year degree, whichever occurred sooner.

We conducted the cost-benefit analysis using multivariate linear regression analysis within an experimental intent-to-treat (ITT) framework, keeping all students randomized to the early college in the treatment group regardless of whether they enrolled or exited the early college. In the overall randomized sample, 92 percent of treatment and 99 percent of comparison group students complied with the initial random assignment, meaning that the ITT estimates are unlikely to differ meaningfully from treatment-on-the-treated estimates.

Table 2 shows baseline differences between early college and traditional high school students in the analysis. Early college students were a bit more likely than traditional high school students to be Black or African American while differences for other baseline characteristics

[5] Some early college lotteries were stratified by student demographic characteristics yielding different probabilities of selection into treatment for members of different demographic groups. Inverse probability weights account for these differing probabilities and guard against possible imbalances between the treatment and comparison groups.

including sex, age, economically disadvantaged status, and middle school achievement and absences were not statistically significant.

Table 2. Baseline Differences of Early College (Treatment) and Traditional High School (Control) Groups, Cost-Benefit Analysis Sample

	Early College Pathway (Treatment) (N=2,068)	Traditional High School Pathway (Control) (N=1,442)	Difference (Treatment – Control)	
	Mean	Mean	Difference	P-Value
Race & Ethnicity				
Black	30.2%	27.7%	2.5 pp	0.021*
Hispanic	7.1%	6.7%	0.4 pp	0.677
White	58.1%	59.9%	-1.8 pp	0.171
Sex				
Male	41.6%	40.9%	0.7 pp	0.721
Age	15.32	15.32	-0.01	0.724
Gifted	14.7%	15.2%	-0.6 pp	0.669
First Generation College	42.1%	41.3%	0.7 pp	0.726
Economically Disadvantaged	51.1%	48.5%	2.7 pp	0.103
8th Grade Achievement				
Math – z-score	0.00	-0.01	0.01	0.775
Reading – z-score	-0.01	0.04	-0.05	0.321
Algebra 1 – pass	21.0%	23.3%	-2.3 pp	0.183
Average # Absences in Middle School	6.44	6.38	-0.05	0.823

NOTES: Control group mean is the unadjusted mean weighted for probability of selection into the early college. Treatment group mean is the adjusted treatment mean, calculated by summing the unadjusted control mean and the impact estimate of a regression of the characteristic on treatment status, including site fixed effects, selection weights, and cluster-robust standard errors. The treatment-control difference is this impact estimate. Statistically significant differences at the $p<0.05$ level are shown by *.

Our impact estimation models controlled for these baseline factors to account for residual imbalances despite the randomization procedure and to enhance the precision of our estimates. We included site (school by cohort) fixed effects because randomization was done within sites, weights reflecting selection probability into the treatment group (Imbens and Rubin, 2015), and cluster-robust standard errors at the high school level, as shown in the equation below:

$$Y_{ij} = \beta_1 T_{ij} + \sum_{j=1}^{J} \beta_{2j} S_j + \beta_3 \boldsymbol{X}_{ij} + \varepsilon_{ij}$$

In this equation, Y_{ij} is the outcome of interest (i.e., cost, benefit, net benefit) for student i in lottery j; T_{ij} is the treatment indicator (T_{ij} = 1 if student i is assigned to the treatment group; T_{ij} = 0 otherwise); S_j is a lottery indicator equal to 1 for students who participated in lottery j and to 0 otherwise (j = 1, . . ., J); β_1 is the estimated average ITT treatment effect; β_{2j} is the fixed effect for each lottery X_{ni_j} is a vector of student covariates; β_3 represents the relationship between student characteristics and the outcome Y; and ε_{ij} represents the random error term.

We imputed missing values for covariates using Stata's multiple stochastic imputation module *mi*, consistent with WWC standards (U.S. Department of Education, 2022). We used Rubin's rules to combine estimates derived from each of ten imputed datasets so that our statistical inferences accounted for the uncertainty introduced by the imputations (Rubin, 1987).

Net Societal Benefits by Subgroup

To answer Research Question 3, we replicated the analyses for Research Question 2 for subgroups. Specifically, we considered the following three sets of subgroups:

- Students who would be the first in their family to go to college and students who would not be the first in their family to go to college;
- Students who identified as members of racial or ethnic groups underrepresented in college (i.e., Black, Hispanic/Latino, Native American, or Multiracial) and students who were not members of racial or ethnic groups historically underrepresented in college (Asian, White); and

- Students who were identified as economically disadvantaged and students who were not economically disadvantaged.

We tested whether differences in impacts between the mutually exclusive subgroups within each set (e.g., economically disadvantaged and not-economically disadvantaged students) were statistically significant using the procedures outlined in Bloom and Michalopoulos (2010). We did not impute subgroup member status, and we excluded students from the subgroup analyses if they were missing the relevant variables to assign them to the subgroups.

Results

Cost to Credential

To answer Research Question 1, we first considered the costs to earning credentials of different types. We found that the early college model is a more expensive route to a high school diploma due to the costs of the dual enrollment courses students take while in high school. Specifically, costs to a high school diploma are $5,961 greater for early college students than for students at traditional high schools (Table 3). When limiting to the subset of students who do not go on to obtain two- or four-year degrees after high school, costs are $2,460 greater for the early college model, a smaller difference than for all high school graduates, attributable to these students taking fewer college courses while they were in high school.

Table 3. Summary of Costs to Credentials, Early College (Treatment) and Traditional High School (Control) Groups

Cost to…	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
A four-year degree	$119,924 (N=627)	$130,329 (N=394)	-$10,405
A two-year degree	$57,422 (N=816)	$66,538 (N=218)	-$9,116
High school diploma (All students)	$49,919 (N=1,957)	$44,338 (N=1,352)	$5,581
High school diploma (Students not earning a degree)	$46,242 (N=900)	$44,092 (N=814)	$2,150

NOTES: Analysis of costs to a four-year degree includes students earning four-year degrees within ten years of entering high school. Analysis of costs to a two-year degree includes students earning two-year degrees within ten years of entering high school. Costs reflect high school costs and costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of dual enrollment coursetaking in high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. Costs after high school are estimated based on enrollment intensity as indicated in National Student Clearinghouse data. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.

However, the early college route to college degrees costs less than the traditional route: $9,131 less to receive a two-year degree and $9,895 less to receive a four-year degree. We explored the drivers of these high-level findings by breaking out the costs incurred for early college and traditional high school students by when those costs were incurred (during or post high school) and by type of postsecondary institution (two-year versus four year) on the way to earning a bachelor's degree (Table 4) or an associate degree (Table 5). In both cases, early college students incur higher costs via enrollments at two-year institutions in high school, as one could expect given the early college model. We also see lower costs, on average, for the high school components of the model (excluding the costs of postsecondary coursetaking in high school) for both bachelor's and associate degree recipients. This suggests that the aspects of

early colleges that are likely to reduce per-student district expenditures (e.g., students taking many college courses and therefore schools needing fewer high school teachers) outweigh factors (such as their small size) that could drive up per-student costs to the districts.

On the way to a bachelor's degree (Table 4), we see sizable savings in the form of lower costs incurred at four-year postsecondary institutions after high school relative to the comparison group (more than $16,000 less, on average).

Table 4. Detailed Breakdown of Costs for Recipients of Four-Year Degrees, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Total Cost	$113,235	$123,130	-$9,895
Costs incurred during high school			
District expenses	$30,553	$36,346	-$5,793
2-year institution costs	$13,761	$1,611	$12,150
4-year institution costs	$2,308	$321	$1,987
Post-high school costs			
2-year institution costs	$1,070	$3,272	-$2,201
4-year institution costs	$65,543	$81,580	-$16,038
Number of Students	627	394	

NOTES: Analysis of costs to a four-year degree includes students earning four-year degrees within ten years of entering high school. Costs reflect costs incurred during high school and post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of dual enrollment coursetaking in high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. Costs after high school are estimated based on enrollment intensity as indicated in National Student Clearinghouse data. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.

With respect to the cost to earn an associate degree (Table 5), the substantially higher costs for early college students during high school are offset by lower costs in two-year institutions post high school. The savings in the cost to an associate degree come from lower costs incurred at four-year institutions post high school in years prior to earning an associate

degree. This would happen, for example, if traditional high school students were more likely to enroll at a four-year institution immediately after high school and subsequently transfer to a two-year school to earn an associate degree.

Table 5. Detailed Breakdown of Costs for Recipients of Two-Year Degrees, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Total Cost	$50,976	$60,107	-$9,131
Costs incurred during high school			
District expenses	$30,250	$35,538	-$5,288
2-year institution costs	$16,544	$2,631	$13,913
4-year institution costs	$87	$53	$35
Post-high school costs			
2-year institution costs	$2,787	$16,465	-$13,677
4-year institution costs	$1,307	$5,419	-$4,112
Number of Students	816	218	

NOTES: Analysis of costs to a two-year degree includes students earning two-year degrees within ten years of entering high school. Costs reflect costs incurred during high school and post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of dual enrollment coursetaking in high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. Costs after high school are estimated based on enrollment intensity as indicated in National Student Clearinghouse data. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.

We also conducted sensitivity analysis to determine whether our NSC-based enrollment proxy was valid. To do this, we replicated our analyses while restricting the sample to students who earned degrees at a public North Carolina postsecondary institution, and then we compared these results to analyses for the same restricted sample using administrative data on credits attempted. The NSC-based analysis for the restricted sample found similar results as the main analysis, although the cost savings were slightly smaller in magnitude because private and out-

of-state four-year enrollments were not included, and members of our comparison group were more likely to enroll in those institutions. We present these results in the Appendix.

Comparing these results for the restricted sample to those using administrative data on credit-taking demonstrates that the NSC proxy measure of enrollment intensity generally functions well. Total costs to a UNC System bachelor's degree are a bit lower for both early college and comparison students when using measures of credits to assign post high school costs Table 6), with a somewhat larger reduction in costs for the early college students relative to analyses using an NSC-based proxy of enrollment intensity (Appendix Table 1). Early college students who enroll full time but take on a smaller credit load (perhaps because of credits they earned while in high school) could explain this finding.

Table 6. Detailed Breakdown of Costs and Credits for Recipients of Four-Year Degrees from the UNC System, Credit-Based Method of Estimating Post High School Costs, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Costs			
Total Cost	$105,741	$117,324	-$11,583
Costs incurred during high school			
District expenses	$30,510	$36,730	-$6,220
NCCCS costs	$13,833	$1,732	$12,102
UNC System costs	$2,533	$417	$2,116
Post-high school costs			
NCCCS costs (curriculum)	$858	$3,037	-$2,179
NCCCS costs (developmental)	$307	$113	$194
UNC System costs	$57,699	$75,294	-$17,594

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Credits			
Total Credits	**161.1**	**142.4**	**18.8**
Credits attempted during high school			
NCCCS credits	54.6	6.8	47.8
UNC System credits	4.8	0.7	4.1
Post-high school credits attempted			
NCCCS credits (curriculum)	3.3	11.7	-8.4
NCCCS credits (developmental)	1.2	0.4	0.8
UNC System credits	97.2	122.7	-25.5
Number of Students	496	280	

NOTES: Analysis of costs to a four-year degree includes students earning four-year degrees through the UNC System. Costs reflect costs incurred during high school and post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of postsecondary coursetaking during and post high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. NCCCS = North Carolina Community College System. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.

With respect to associate degrees, we find somewhat smaller total cost savings for the early college model when using the credit-based accounting (Table 7) than the NSC proxy method (Appendix Table 2). In this case, lower estimates of post high school costs incurred at NCCCS by comparison students drive the difference from the proxy method.

Table 7. Detailed Breakdown of Costs and Credits for Recipients of Two-Year Degrees from NCCCS, Credit-Based Method of Estimating Post High School Costs, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Costs			
Total Cost	$50,797	$57,972	-$7,174
Costs incurred during high school			
District expenses	$30,231	$35,571	-$5,340

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
NCCCS costs	$17,099	$3,111	$13,988
UNC System costs	$53	$36	$17
Post-high school costs			
NCCCS costs (curriculum)	$2,177	$16,175	-$13,998
NCCCS costs (developmental)	$467	$620	-$153
UNC System costs	$770	$2,459	-$1,688
Credits			
Total Credits	**79.1**	**82.0**	**-2.9**
Credits attempted during high school			
NCCCS credits	67.1	12.1	55.1
UNC System credits	0.1	0.1	0.0
Post-high school credits attempted			
NCCCS credits (curriculum)	8.5	62.9	-54.4
NCCCS credits (developmental)	1.8	2.4	-0.6
UNC System credits	1.5	4.5	-2.9
Number of Students	764	172	

NOTES: Analysis of costs to a two-year degree includes students earning two-year degrees from the North Carolina Community College System (NCCCS). Costs reflect costs incurred during high school and post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of postsecondary coursetaking during and post high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.

Using administrative data to estimate costs allowed us to explore in more depth the mechanisms associated with the cost savings. For example, among UNC system four-year degree graduates (Table 6), early college students attempted 25 fewer (comparatively more expensive) UNC credits, on average, while they attempted about 40 more (comparatively less expensive) NCCCS credits. This nets out to cost savings despite the average early college student earning more credits than comparison students and more than needed for a bachelor's degree. For

students earning two-year degrees through NCCCS (Table 7), both the treatment and control groups took roughly the same number of credits at NCCCS, but traditional high school students accrued more UNC credits prior to earning a two-year degree, on average, possibly reflecting a greater likelihood of starting at a UNC school and transferring to NCCCS.

Last, we considered expected costs to students and families of earning degrees via the early college and traditional high school routes. Here we focused on costs incurred post-high school and leveraged net price data from IPEDS. Table 8 presents results for four-year degrees and Table 9 shows results for two-year degrees. In our primary analyses (inclusive of all institutions and degree-earners), we found that the early college model yields savings to students and families for both bachelor's and associate degrees. These savings exceed the savings to society, despite costs to students and families accounting for just a portion of the total costs to society of the degrees. Average student and family savings are $13,144 for four-year degrees and $14,454 for two-year degrees. Our sensitivity analyses, also shown in the tables, show similar patterns in cost savings for students and their families.

Table 8. Detailed Breakdown of Costs to Students for Recipients of Four-Year Degrees, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
All 4-Year Degree Recipients (NSC approach)			
Total costs to students	$47,168	$60,312	-$13,144
2-year institution costs	$1,048	$2,780	-$1,732
4-year institution costs	$46,120	$57,532	-$11,412
Number of Students	627	394	
UNC System 4-Year Degree Recipients (NSC approach)			
Total costs to students	$42,305	$52,872	-$10,567
2-year institution costs	$963	$2,716	-$1,753
4-year institution costs	$41,342	$50,156	-$8,814
Number of Students	496	280	

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
UNC System 4-Year Degree Recipients (NC administrative data approach)			
Total costs to students	$38,874	$50,697	-$11,823
NCCCS costs (curriculum)	$714	$2,396	-$1,683
NCCCS costs (developmental)	$245	$96	$149
UNC System costs	$37,916	$48,205	-$10,289
Number of Students	496	280	

NOTES: Analysis of costs to students of a four-year degree includes students earning four-year degrees within ten years of entering high school. Includes post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. The NSC approach estimates costs based on enrollment intensity as indicated in National Student Clearinghouse data and using average net price data from the Integrated Postsecondary Education Data System. The NC administrative data approach estimates costs based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment, also using average net price data from the Integrated Postsecondary Education Data System. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Excludes out-of-pocket costs to students of dual enrollment coursetaking. Results weighted by the inverse of students' probability of being selected into the early college.

Table 9. Detailed Breakdown of Costs to Students for Recipients of Two-Year Degrees, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
All 2-Year Degree Recipients (NSC approach)			
Total costs to students	$3,111	$17,564	-$14,454
2-year institution costs	$2,088	$12,668	-$10,580
4-year institution costs	$1,023	$4,896	-$3,873
Number of Students	816	218	
NCCCS 2-Year Degree Recipients (NSC approach)			
Total costs to students	$2,386	$15,554	-$13,169
2-year institution costs	$1,761	$13,560	-$11,799
4-year institution costs	$625	$1,995	-$1,370
Number of Students	764	172	
NCCCS 2-Year Degree Recipients (NC administrative data approach)			
Total costs to students	$2,492	$14,300	-$11,809

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
NCCCS costs (curriculum)	$1,539	$11,924	-$10,385
NCCCS costs (developmental)	$374	$534	-$160
UNC System costs	$578	$1,842	-$1,264
Number of Students	764	172	

NOTES: Analysis of costs to students of a two-year degree includes students earning two-year degrees within ten years of entering high school. Includes post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. The NSC approach estimates costs based on enrollment intensity as indicated in National Student Clearinghouse data and using average net price data from the Integrated Postsecondary Education Data System. The NC administrative data approach estimates costs based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment, also using average net price data from the Integrated Postsecondary Education Data System. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Excludes out-of-pocket costs to students of dual enrollment coursetaking. Results weighted by the inverse of students' probability of being selected into the early college.

Costs and Benefits

Answering Research Question 2, our next set of results considers whether, on average, the societal benefits of higher levels of educational attainment associated with the early college model exceed the costs of delivering that education. We include the full sample of originally randomized students in these analyses regardless of whether they earned a degree.[6] As such, students who do not go on to postsecondary education would not incur the associated costs, potentially counteracting the savings described in our Research Question 1 analyses for students who do earn degrees.

[6] We do, however, continue to exclude students with documented exits from the North Carolina public high school system from the analyses (and who simply went missing without an indication of having dropped out or graduated); this is because we cannot account for their full set of high school costs. These students are considered as attritors from the randomized sample. As noted in the methods section, attrition and differential attrition rates qualify as low attrition under cautious assumptions according to WWC standards (U.S. Department of Education, 2022).

Table 10 shows that when including all students in the analysis regardless of degree attainment, early college students and traditional high school students have essentially the same costs of education (about $73,000 in 2020 dollars) from grade nine through six years after expected twelfth grade year (or attainment of a bachelor's). The lower costs to earning an associate or bachelor's degree (described above) seem to outweigh the larger share of students earning these degrees and accruing those costs. Given that higher levels of educational attainment result in larger lifetime societal benefits, we find that early college students, on average, yield nearly $16,000 more in benefits than traditional high school students. This nets out to about $15,600 per student in larger net societal benefits for the early college model (subtracting off a statistically insignificant $330 in higher average costs of education).

Table 10. Impact of Early College Model on Societal Costs, Benefits, and Net Benefits, Through Ten Years After Entering Ninth Grade, Overall

	Early College Pathway (Treatment) (SD) (N=2,068)	Traditional High School Pathway (Control) (SD) (N=1,442)	Difference (Treatment – Control) (SE)	P-Value	Effect Size
Costs	$72,979 ($42,654)	$72,648 ($50,138)	$331 ($1,714)	0.847	0.01
Benefits	$259,458 ($100,748)	$243,494 ($105,935)	$15,965 ($3,801)	<0.001***	0.16
Net benefits	$186,479 ($87,354)	$170,846 ($88,435)	$15,633 ($3,776)	<0.001***	0.18

NOTES: Control group mean is the unadjusted mean weighted for probability of selection into the early college. Treatment group mean is the adjusted treatment mean, calculated by summing the unadjusted control mean and the impact estimate of a regression of the outcome on the treatment indicator, including baseline covariates, site fixed effects, selection weights, and cluster-robust standard errors. Missing baseline covariates are imputed using multiple stochastic imputation. Statistically significant differences at the $p<0.05$ level are shown by *, at the $p<0.01$ level by **, and at the $p<0.001$ level by ***.

Net Societal Benefits by Subgroup

An advantage of the estimates we used to determine benefits to different levels of educational attainment (Carroll and Erkut, 2009) is that they vary by race or ethnicity and gender. For example, the estimated net benefit to taxpayers of increasing educational attainment from high school dropout to college graduate is nearly twice as large for Black men than for white women. As Table 11 shows, we found positive impacts of the early college model on net benefits for all subgroups, including first generation and not first-generation students, members of racial and ethnic groups underrepresented and racial and ethnic groups not underrepresented in higher education, and economically disadvantaged and not-economically disadvantaged students. The impacts on net benefits were statistically significant for all subgroups except for not first-generation students, for whom the impact was only marginally significant.

Table 11 also shows the differential impacts, i.e., whether the impacts for mutually exclusive subgroups were different from each other. As shown, the impact on net benefits was higher for economically disadvantaged students and for first generation students, though both differential impact estimates were only marginally significant. A differentially larger impact on economically disadvantaged students is consistent with prior findings (Edmunds et al., 2020) that showed that impacts of the early college model on bachelor's degree attainment are positive and statistically significant for economically disadvantaged students but that there is an insignificant (and directionally negative) impact for not economically disadvantaged students.

Table 11. Impact of Early College Model on Societal Costs, Benefits, and Net Benefits, Through Ten Years After Entering Ninth Grade, Subgroups

Outcome		First Generation		Underrepresented Race/Ethnicity		Economically Disadvantaged	
		First Gen. (N=1,197)	Not First Gen. (N=1,805)	Underrep. (N=1,248)	Not underrep. (N=2,256)	EDS (N=1,688)	Not EDS (N=1,734)
Costs	Control	$64,077	$80,127	$77,862	$69,847	$65,228	$80,127

	Mean						
	Impact	-$1,168	-$263	-$4,180*	$2,704	$1,431	-$1,746
	Differential Impact	-$906		-$6,884*		$3,177	
Benefits	Control Mean	$222,396	$260,264	$286,506	$220,066	$236,229	$251,619
	Impact	$20,320***	$8,851[t]	$12,315*	$16,787***	$23,864***	$7,959
	Differential Impact	$11,468		-$4,472		$15,905*	
Net Benefits	Control Mean	$158,319	$182,538	$208,644	$150,218	$171,001	$171,493
	Impact	$21,488***	$9,114[t]	$16,495**	$14,083***	$22,433***	$9,705*
	Differential Impact	$12,374[t]		$2,412		$12,728[t]	

NOTES: Control group mean is the unadjusted mean weighted for probability of selection into the early college. Impact estimate from a regression of the outcome on the treatment indicator, including baseline covariates, site fixed effects, selection weights, and cluster-robust standard errors. Differential impact reflects the difference in impact estimates between the subgroup (i.e., first generation, underrepresented race/ethnicity, and economically disadvantaged students) and students who are not members of the subgroup but with non-missing information for the variable that defines the subgroup. Subgroup assignment based on unimputed data though missing baseline covariates are imputed using multiple stochastic imputation. Statistically significant differences at the $p<0.10$ level are shown by [t], at the $p<0.05$ level by *, at the $p<0.01$ level by **, and at the $p<0.001$ level by ***.

Discussion

Overall, this study shows that the early college model is a cost-efficient way to earn a postsecondary degree. We found savings of about $10,000 relative to the traditional high school pathway for both bachelor's and associate degrees. These findings were robust to differing ways of defining the costs. Our analyses also help to document the primary sources of cost savings for the early college model—these students take more credits, on average, during high school at comparatively less expensive institutions than post high school at more expensive schools.

Given the cost savings to earning a credential, higher rates of credential-earning for early college students, and the well-established societal benefits from a more highly educated population, it is unsurprising that our experimental results showed that the benefits of the early college pathway outweigh its costs and do so to a larger degree than the traditional high school pathway. Specifically, we estimated that net benefits to society are about $15,630 larger for the

early college model than the traditional high school pathway, with the roughly $16,000 in additional benefits far exceeding the statistically insignificant $330 in added costs. This yields a cost-benefit ratio of roughly 48:1. These findings are consistent with and even higher than results from other cost-benefit analyses of the early college model, one of which found a cost-benefit ratio of 15:1 (Atchison et al., 2021) and one of which found a cost-benefit ratio of 17:1 (Washington Institute for Public Policy, 2019). Additionally, we found larger net benefits for first generation students and economically disadvantaged students than their counterparts not in those groups, though the differential impact estimates are only marginally significant.

These results suggest that the early college model is a promising approach for reducing costs to earning postsecondary credentials while increasing benefits to society, potentially with especially pronounced positive impacts for subgroups of students for whom the costs of college may be most burdensome and the benefits to gaining a college education the most pronounced.

References

American Institutes for Research. (Undated). "Mapping Early College Programs Across the U.S." https://www.air.org/project/evaluating-impact-early-college-high-schools/mapping-early-colleges-across-us

Atchison, D., Zeiser, K. L., Mohammed, S., Knight, D. S., & Levin, J. (2021). The Costs and Benefits of Early College High Schools. *Education Finance and Policy*, 16(4), 659-689. https://doi.org/10.1162/edfp_a_00310

Bahr, P. R., Dynarski, S. M., Jacob, B., Kreisman, D., Sosa, A., & Wiederspan, M. (March, 2015). *Labor market returns to community college awards: Evidence from Michigan*. Retrieved from New York: https://files.eric.ed.gov/fulltext/ED557080.pdf

Berger, A., Turk-Bicakci, L., Garet, M., Song, M., Knudson, J., Haxton, C., . . . Cassidy, L. (2013). *Early College, early success: Early College High School Initiative impact study*. Retrieved from Washington, DC: https://www.air.org/sites/default/files/downloads/report/ECHSI_Impact_Study_Report_Final1_0.pdf

Bloom H. S., Michalopoulos C. (2010). *When is the story in the subgroups? Strategies for interpreting and reporting intervention effects on subgroups*. https://www.mdrc.org/publication/when-story-subgroups

Carnevale, A. P., Garcia, T. I., Ridley, N., & Quinn, M. C. (2020). *The overlooked value of certificates and associate's degrees: What students need to know before they go to college*. Retrieved from Washington, DC: https://files.eric.ed.gov/fulltext/ED604942.pdf

Carroll, S. J., & Erkut, E. (2009). *The benefits to taxpayers from increases in students' educational attainment*. Retrieved from Santa Monica, CA: https://www.rand.org/pubs/monographs/MG686.html

Cuellar, S. & Allen, T.O. (2024). A qualitative study on the socialization and transitions of early college high school graduates in Texas. *Journal of Advanced Academics,* 35:3, 368-391.

Dagdar, M., & Trimble, M. J. (2015). Labor market returns to sub-baccalaureate credentials: How much does a community college degree or certificate pay? . *Educational Evaluation and Policy Analysis, 4*(399-418).

Edmunds, J. A., Unlu, F., Phillips, B., Glennie. E. J., & Mulhern, C. (in press). The impact of early colleges on postsecondary performance and completion. *AERA Open*.

Edmunds, J. A., Unlu, F., Furey, J., Glennie, E., & Arshavsky, N. (2020). What happens when you combine high school and college? The impact of the early college model on postsecondary perfromance and completion. *Educational Evaluation and Policy Analysis, 42*(2). doi:https://doi.org/10.3102/0162373720912249

Edmunds, J. A., Unlu, F., Glennie, E., Bernstein, L., Fesler, L., Furey, J., & Arshavsky, N. (2017). Smoothing the transition to postsecondary education: the impact of the early college model. *Journal of Research on Educational Effectiveness, 10*(2), 297-325.

Edunomics Lab, National Education Resource Database on Schools (2022). FY2018-19. North Carolina.

Giani, M. S., Attewell, P. A., & Walling, D. (2020). The value of an incomplete degree: Heterogeneity in the labor market benefits of college non-completion. *The Journal of Higher Education, 91*(4), 514-539.

Hout, M. (2012). Social and economic returns to college education in the United States. *Annual Review of Sociology, 38*, 379-400.

Imbens, G. W. & Rubin, D. B. (2015). *Causal Inference for Statistics, Social, and Biomedical Sciences: An Introduction*. New York: Cambridge University Press.

Institute of Education Sciences. (2020). *Cost Analysis: A Toolkit*. Washington, DC: Institute of Education Sciences Retrieved from https://ies.ed.gov/pubsearch/.

Jepsen, C., Troske, K., & Coomes, P. (2014). The labor-market returns to community college degrees, diplomas, and certificates. *Journal of Labor Economics, 32*(1), 95-121.

Lawrence, B. K., Bingler, S., Diamond, B., Hill, B., Hoffman, J. L., Howley, C. D., . . . Washor, E. (2002). *Dollars & sense: the cost-effectiveness of small schools*. Retrieved from Cincinnati, OH:

National Center for Education Statistics (2023). *Digest of Education Statistics: 2022*. Tables 334.10 and 334.30. https://nces.ed.gov/programs/digest/d22/

North Carolina Department of Public Instruction (2021). "AFR/MFR Recommendations for Consistent Per Pupil Reporting." https://www.dpi.nc.gov/documents/fbs/resources/afr-mfr-recommendations-2021pdf/download?attachment

Rubin D. B. (1987). *Multiple imputation for nonresponse in surveys*. John Wiley.

Shand, R., & Bowden, A. B. (2021). Empirical Support for Establishing Common Assumptions in Cost Research in Education. Journal of Research on Educational Effectiveness, 15(1), 103–129. https://doi.org/10.1080/19345747.2021.1938315

Song, M., & Zeiser, K. (2021). Early college, continued success: Longer-term impact of Early College High Schools. *Journal for Research on Educational Effectiveness, 14*(1), 116-142. doi:DOI: 10.1080/19345747.2020.1862374

U.S. Department of Education. (2022). What Works Clearinghouse Procedures and Standards

Washington State Institute for Public Policy (2023). Benefit-cost technical documentation. https://www.wsipp.wa.gov/TechnicalDocumentation/WsippBenefitCostTechnicalDocumentation.pdf

Washington State Institute for Public Policy (2019). *Early college high school (for high school students).* http://www.wsipp.wa.gov/BenefitCost/Program/789

Zhang, L., Liu, X., & Hu, Y. (2024). Degrees of return: Estimating internal rates of return for college majors using quantile regression. *American Educational Research Journal*.

APPENDIX

This appendix displays results from a sensitivity analysis that used the NSC proxy method of determining postsecondary enrollment intensity and applied this method to the sample of students that earned a degree from a North Carolina public postsecondary institution. To facilitate a comparison to a credit-based accounting of enrollments using administrative data, we excluded costs from enrollments outside of North Carolina public postsecondary institutions.

Appendix Table 1 presents estimates of costs to a bachelor's degree at a UNC System school. On average, costs to bachelor's degrees are lower at the public North Carolina institutions for both the early college and comparison groups than when considering the full sample and enrollments at private and out-of-state institutions. However, the magnitude of this difference is larger for members of the comparison group, which contributes to a somewhat smaller total cost savings for early college students ($8,958) than in the main analysis ($9,895). For context, early college students disproportionately earned bachelor's degrees at UNC system schools (79 percent of treatment group bachelor's degree-earners versus 71 percent of comparison group bachelor's degree-earners).

Appendix Table 2 shows estimates of costs to an associate degree from a NCCCS institution. We found lower costs (for both groups) on the way to NCCCS associate degrees and somewhat smaller total cost savings for early college students ($8,434) when only considering North Carolina public postsecondary enrollments relative to the main analysis ($9,131). Larger reductions in spending at four-year schools post high school are the primary drivers of the difference in total costs.

Appendix Table 1. Detailed Breakdown of Costs for Recipients of Four-Year Degrees from the UNC System, NSC-Based Method of Estimating Post High School Costs, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Total Cost	$110,608	$119,566	-$8,958
Costs incurred during high school			
District expenses	$30,510	$36,730	-$6,220
2-year institution costs	$13,833	$1,732	$12,102
4-year institution costs	$2,533	$417	$2,116
Post-high school costs			
2-year institution costs	$1,082	$3,420	-$2,338
4-year institution costs	$62,650	$77,266	-$14,616
Number of Students	496	280	

NOTES: Analysis of costs to a four-year degree includes students earning four-year degrees through the University of North Carolina System. Costs reflect costs incurred during high school and post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of dual enrollment coursetaking in high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. Costs after high school are estimated based on enrollment intensity as indicated in National Student Clearinghouse data, restricting to enrollments at North Carolina public postsecondary institutions. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.

Appendix Table 2. Detailed Breakdown of Costs for Recipients of Two-Year Degrees from NCCCS, NSC-Based Method of Estimating Post High School Costs, Early College (Treatment) and Traditional High School (Control) Groups

	Early College Pathway (Treatment)	Traditional High School Pathway (Control)	Difference (Treatment – Control)
Total Cost	$50,714	$59,148	-$8,434
Costs incurred during high school			
District expenses	$30,231	$35,571	-$5,340
2-year institution costs	$17,099	$3,111	$13,988
4-year institution costs	$53	$36	$17
Post-high school costs			
2-year institution costs	$2,488	$17,719	-$15,231
4-year institution costs	$843	$2,711	-$1,868
Number of Students	764	172	

NOTES: Analysis of costs to a two-year degree includes students earning two-year degrees from the North Carolina Community College System (NCCCS). Costs reflect costs incurred during high school and post-high school costs of postsecondary enrollments up to and including the year in which the credential was earned. Costs of dual enrollment coursetaking in high school are based on credits attempted at North Carolina public postsecondary institutions, assigning 32 credits as equivalent to a full-time equivalent enrollment. Costs after high school are estimated based on enrollment intensity as indicated in National Student Clearinghouse data, restricting to enrollments at North Carolina public postsecondary institutions. All dollar amounts are inflation-adjusted to 2020 using the Consumer Price Index. Results weighted by the inverse of students' probability of being selected into the early college.