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The Effects of Start-Up Charter Schools on Academic Milestones

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About the Report Series

This is the final study in a three-part series commissioned by the State Charter Schools Commission and performed by the Center for State and Local Finance. The series analyzes the economic impact of start-up charter schools on individuals that attend them, the communities they serve, and on the state of Georgia as a whole. Examining the economic impact of charter schools on individuals that attend them and the communities in which the schools are located, has been previously undertaken in only a few other states. This series of reports, focusing on the Georgia experience with start-up charter schools, makes a meaningful contribution to this literature. Reports one and three examine the economic impact that start-up charter schools have on students. The second report examines the economic impact of start-up charter schools on the communities in which they are located through changes to property values.

The first report, *Review of Charter Schools' Effects on Student Achievement and Life Outcomes*, summarized the academic literature on the impact of charter schools on academic development and achievement as well as the impacts achievement can have in the long run. The effect of charter school attendance on student academic achievement and life outcomes has been long debated and extensively researched. Most commonly, researchers have used changes in tests scores to measure student achievement, yielding mixed results: Studies estimating changes in student achievement across multiple schools have found no, small positive, or even small negative effects of charter school enrollment. In addition to studies of academic performance, an emerging literature is providing some evidence that charter schools have been able to improve student life outcomes, including high school graduation rates and earnings.

The second report, *Effect of Start-Up Charter Schools on Nearby Property Values*, examines the economic impact of start-up charter schools on the communities surrounding them by analyzing the effects on real property values. We analyze the variation in sales prices of houses across school attendance zones, as well as the variation in house values based on the distance from the start-up charter schools. We find that for start-up charter schools with priority attendance zones, households are willing to pay a premium to be within one half-mile of the school; this premium is larger in the city of Atlanta. For start-up charter schools without priority zones, the positive economic effect is mostly isolated to charter schools in the Atlanta suburbs.

The research in this third report supports the existing literature on student life outcomes summarized in report one. We find that attending a Georgia start-up charter high school increases the likelihood of high school graduation and those students are more likely to enroll in college than comparison groups of students who attended charter middle schools but then switched to traditional public high schools (control group). The students who attend a start-up charter high school are also more likely to persist in college and are more likely to earn a college degree or certificate than the control group. These academic milestones, such as high school graduation, college enrollment and degree completion, are predictive of a student's future outcomes in the labor market.

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Introduction

Since the first charter school opened in 1992, 42 states and the District of Columbia have adopted provisions allowing charter schools to operate (Epple et al. 2015). Advocating reform to struggling public education systems, the proponents of charter schools envisioned that charter schools' autonomy would allow charter schools to innovate and improve educational outcomes for their students. Proponents also hoped that the increased competition for students would spur improvements in traditional public schools (TPS). Improved academic performance in both settings is important as research has found that it leads to better economic outcomes for both individuals and communities (Hanushek and Kimko 2000; Card 1999).

The effect of charter school attendance on students' academic achievement and life outcomes has been long debated and extensively researched; research on charter schools improving student achievement has been conducted in at least 27 states (Cremata et al. 2013). Typically, researchers have used changes in tests scores, from elementary and middle school grades, to measure student achievement. This extensive research on the effectiveness of charter schools has yielded mixed results (see Bluestone 2016 for a review of the literature). Less is known about the impact that these schools have on other metrics of student success either in high school or college.

This report examines the impact of Georgia's start-up charter schools on students' academic milestones — high school graduation, college enrollment and degree completion. These critical educational achievements are predictive of a student's future outcomes in the labor market. We use Georgia's Academic and Workforce Analysis and Research Data System (GA•AWARDS), housed by the Governor's Office of Student Achievement, for this study. This longitudinal data system starts collecting data on Georgia public school students upon their entrance to Georgia's Pre-K Program, if they participate, all the way through their role in Georgia's labor market.

We find that attending a Georgia charter high school increases the likelihood of high school graduation by roughly 4 percentage points and that such students are 6 percentage points more likely to enroll in college than comparison groups of students who attended charter middle schools but then switched to traditional public high schools. The students who attend a charter high school are also about 8 percentage points more likely to persist in college for two consecutive semesters and 2 percentage points more likely to earn a college degree or certificate than the control group.

We use an average treatment effects model to isolate the differences in critical educational outcomes between students who were enrolled in start-up charter high schools and a group of matched students who attended traditional public high schools. All the students studied attended a charter middle school; this sample restriction controls for selection effects, which would otherwise bias the results. We find that attending a Georgia charter high school increases the likelihood of high school graduation by roughly 4 percentage points and that such students are 6 percentage points more likely to enroll in college than comparison groups of students who attended charter middle schools but then switched to traditional public high schools (the control group). The students who attend a charter high school are also about 8 percentage points more likely to persist in college for two consecutive semesters and 2 percentage points more likely to earn a college degree or certificate than the control group.

These findings are significant for the labor market and economy, as there is an earnings premium associated with reaching these academic milestones. For instance, the U.S. Bureau of Labor Statistics finds that workers who graduate from college earn on average 36 percent more per week than those with only a high school diploma. These additional earnings have a positive economic impact on the communities in which they are spent.

The report is organized as follows. The types of charter schools in Georgia are briefly reviewed next. The third section discusses the economic theory on the link between academic achievement and economic impact. The fourth section summarizes the measures used in the literature to assess charter school success. The fifth section examines data and research methods. The sixth section reviews summary statistics, and the seventh section describes model specification, results and robustness checks. The concluding section suggests areas for future research.

Charter Schools in Georgia

While charter schools are public schools, two key factors differentiate them from traditional public schools. First, rather than children being assigned to a specific public school, parents can choose whether to send their children to a charter school. Second, charter schools have increased flexibility in how they educate students in exchange for increased accountability. The flexibility pertains to both state and district regulations that govern operations as well as the nature of the educational programs provided. Charter schools can differ from traditional public schools in several ways, such as the length of the school day, mandatory summer school, the instructional methods offered, and so forth.

Per the 2017-18 Georgia Charter Schools Annual Report, 113 charter schools were operating in Georgia at the start of the 2017-18 school year (not including those in charter system schools). These schools may be divided into two broad types (Georgia Department of Education 2014; Types of Charters):

- **Start-Up Charter School:** A new school created by a petition made by a nonprofit governing board. Start-up charter schools may determine their own attendance zones, including priority attendance zones.

- **Conversion Charter School:** A charter school that existed as a local public school prior to becoming a charter school. Entrance into conversion charter schools is usually guaranteed for students residing within the school attendance boundaries as determined by the local school board.
- **Charter System School:** A charter system is a local school district that operates under a charter between the school district as the charter petitioner and the State Board of Education. Schools in a charter system are different from conversion and start-up charter schools. The school district, not the school and school governing board, has the contract with the state. Thus, schools in charter systems are generally more similar to a traditional public school and operate in a comparable manner. For instance, the Atlanta Public School district is now a charter system.

At the start of the 2017-18 school year, charter school students (not including charter systems) represented 4.9 percent of all K-12 public school students in Georgia. There are considerably more schools in charter systems and thus more students. Due to the similarities conversion charters schools and charter systems have to traditional public schools, we restrict our analysis to start-up charter schools in this report.

The Economic Theory of Academic Achievement and Economic Impact

This study relies on the theory that academic achievement leads to improved job outcomes, which make a positive economic impact on the community. Economic theory has long held that increased business investment in new machines and equipment (capital investment) fosters economic growth. In 1962, economist Gary Becker expanded the concept of capital investment to include schooling and training. Economic theory holds that better-educated workers are more productive, which can lead to both economic growth, improving the larger economy, and higher wages, an economic benefit to individuals. Spending on schooling and training is now commonly referred to as investing in human capital.

. . . higher educational attainment leads to substantially higher lifetime earnings . . .

Since Becker published his article, the literature on human capital has grown dramatically and fits into two broad categories: the macroeconomic effects of education on countries' growth rates and the higher earnings associated with individuals' investment in education. While both areas of research have been fraught with debates about appropriate research methods, there is consensus on two broad outcomes. First, in the macroeconomic setting, better schooling, measured by cognitive development in a country, is related to greater economic growth (Hanushek and Kimko 2000; Hanushek and Woessmann 2012). Second, from the perspective of individuals, higher educational attainment leads to substantially higher lifetime earnings (Card 1999; Heckman et al. 2006). This study focuses on the second category, primarily on educational attainment.

Charter Schools: Measures of Success Used in the Literature

This section explores the empirical literature on charter schools' effects on academic achievement, graduation rates, wages and other life outcomes. The discussion is relatively brief and limited to high-quality studies that use methods relevant to this study. (For a thorough discussion of this literature, see Bluestone et al. (2016)).

For charter schools to have a measurable economic impact, they need to improve outcomes for students later in life. Charter schools that increase the percentage of students who graduate from high school, attend college, obtain degrees and earn higher salaries will have positive economic impacts on their communities. A recent stream of the literature examines the potential effects that charter schools have on these outcomes. Additionally, many studies examine the role that charter schools play in academic achievement, which we outline first.

ACADEMIC ACHIEVEMENT

An extensive body of work explores the effects that charter schools have on academic achievement, as measured by performance on standardized tests. This rich literature has measured charter school effects on academic performance at the elementary and middle school levels. Many of these studies rely on a lottery research design.

Student achievement has been firmly linked to better life outcomes such as increased high school graduation rates and higher wages; consequently, the effects found in this literature are a reasonable predictor of better economic outcomes for students later in life.

The literature on how charter schools affect student achievement is contentious. Many of the studies using the lottery method provide strong evidence that certain charter schools can improve student achievement. Because students and their parents choose to enroll in charter schools, any study that compares charter students to traditional public school students has an inherent selection bias issue. Consequently, many studies that attempt to pinpoint the impacts of charter school attendance rely on a lottery research design, which takes advantage of the random selection that an attendance lottery provides in oversubscribed charter schools. Researchers compare the performance of students chosen for the charter school to that of students not chosen (and who consequently attend a traditional public school). When schools that operate in varying contexts and areas are studied together, even when using the lottery method as Gleason et al. (2010) did, the effects on average tend to be small or zero. Research shows that this low average effect is due to the variability in effects across schools. More recent studies that have tried to uncover the source of this variation suggest that charter schools that serve disadvantaged students — typically ones in urban settings that focus on strict

discipline, tutoring and longer school days (often referred to as the No Excuses model in the literature) — do improve student achievement. Other types of charter schools have not been found to outperform traditional public schools in any consistently measurable way.

Student achievement has been firmly linked to better life outcomes such as increased high school graduation rates and higher wages; consequently, the effects found in this literature are a reasonable predictor of better economic outcomes for students later in life. (For instance, see Angrist et al. (2016), Sass et al. (2016) and Dobbie and Fryer (2013).)

OTHER OUTCOMES

Studies testing the effect of attending charter schools on outcomes that directly relate to economic impacts such as graduation rates, higher education milestones and wage effects have all been published since 2010. This makes sense because the first classes of charter school students have only recently begun graduating from high school, so there are limited numbers of charter school alumni for which these outcomes can be measured. Also, the data must be available for recent years to capture both attendance at charter schools and observable outcomes post high school graduation. While the literature is not well established, the studies that have been able to track students into the workforce find positive effects from enrollment in a charter school on graduation rates, education outcomes and wage effects.

. . . they found that charter enrollment predicted longer college persistence and higher earnings . . .

Some studies have found that enrollment in charter high schools increases the chances of high school graduation and college attendance (Booker et al. 2010; Clark et al. 2015). Unlike test scores, high school graduation and earnings immediately after graduation are one-time events; any study of charter schools' effects on these outcomes cannot rely on multiple observations for a student over time to help control for potential charter school selection bias, inherent when families chose whether to attend a charter school. To account for such bias, Booker et al. (2010) considered only students who had previously attended a charter middle school.[1] In a follow-up study, similarly designed except with a matching protocol implemented to further correct for any charter selection bias, the authors found similar results for high school graduation and college attendance. In addition, they found that charter enrollment predicted longer college persistence and higher earnings (Sass et al. 2016).

Two lottery-style studies conducted on oversubscribed charter schools in Boston and Harlem found positive effects of charter enrollment on some noncognitive outcomes (Angrist et al. 2016; Dobbie and Fryer 2013). Charter schools were found to increase the chances that a student would enroll in a four-year college rather than a two-year college, but the researchers found no evidence that the charter schools increased the likelihood of high school graduation (Angrist et al. 2016). The students who

[1] Middle school enrollment grades can vary between school districts. For the purposes of this report, middle school includes grades 6-8.

attended Harlem's charter schools were more likely to enroll in college, girls were less likely to become pregnant as teens, and male students were much less likely to be incarcerated than students who participated in the lottery but attended Harlem's traditional public schools (Dobbie and Fryer 2013).

The few studies that look at broader outcomes such as graduation rates and earnings are recent and focus only on schools in Chicago, New York, Boston and Florida (e.g., Angrist et al. 2016; Dobbie and Fryer 2013; Sass et al. 2016). However, these studies might provide the best evidence that charter schools are having positive economic impacts on communities and individuals through improved academic achievement.

Data and Research Methods

This analysis attempts to establish a causal relationship between ninth-grade attendance at a start-up charter school in Georgia and the achievement of certain critical academic outcomes that are highly predictive of better economic outcomes for students in Georgia. For this study, we measure high school graduation, postsecondary enrollment, persistence in postsecondary education, and college or technical school completion. Due to the timing of this study and when the charter high schools in Georgia opened, we can only report limited data on postsecondary degree attainment and labor market outcomes.

Our analysis centers on the students the data allow us to follow, from a start-up charter school through high school graduation and beyond, to measure the effects that start-up charter schools have on these outcomes.

We rely on the GA•AWARDS data set. These data, first established through the Race to the Top statewide longitudinal data system grant, are generated by many state education and workforce agencies and the university systems. The data, which are housed and maintained by the Governor's Office of Student Achievement, include information on Georgia's students from enrollment in pre-K through their entrance into the labor market for the years 2007-16. The student-level dataset contains information on students' performance on tests, demographics, teachers, graduation outcomes, college and technical school enrollment, postsecondary degree attainment and any employment records.[2]

The data follow Georgia students throughout the full calendar years of 2007-16. Many start-up charter schools serve only elementary and middle school-aged students, so the data system currently contains limited labor market outcomes for these students. Additionally, many of the start-up charter schools are newly established. Our analysis

[2] College enrollment includes out-of-state colleges and universities.

centers on the students the data allow us to follow, from a start-up charter school through high school graduation and beyond, to measure the effects that start-up charter schools have on these outcomes.

Isolating a causal relationship between attending a charter school and later life outcomes requires methods that account for the potential selection (empirical) bias from more interested students and families selecting into charter schools. To do so, we estimate average treatment effects within matched ninth-grade students attending start-up charter high schools (treatment) and traditional public schools or conversion charter high schools (control) — all of whom attended a start-up charter school for eighth grade. This method, frequently used in the literature, reduces the likelihood that neither selection into a charter school nor student population differences are influencing the findings. Our control group, therefore, is students who attended eighth grade at a charter middle school and then attended a traditional public high school; our treatment group consists of students who attended a charter middle school and continued into a start-up charter high school.

Individual charter schools differ in the legal framework under which they operate, complicating our analysis. Each school has its own curricular focus, instructional style and teachers. They follow different schedules and serve different communities. Because of these variations, much of the research on charter schools has been specific to a school or small set of schools within a given state, making it difficult to generalize the findings to other charter schools.

All the differences across charter schools create methodological complications when attempting to evaluate the performance of an individual school. Comparing the outcomes of students who attended a charter school to those who attended a traditional public school suffers from potential sample selection bias. By choosing to enroll, or attempting to enroll, in a charter school, a family and student are indicating intrinsic motivation and a potentially higher value placed on education than families and students who do not attempt to enroll. Any effect found in a study that does not correct for this potential selection bias could just be capturing the effect of the higher levels of motivation and value placed on education rather than the charter school's impact on the student. (For a full review of the literature on the effect of charter schools on student achievement and other life outcomes, see Bluestone et al. (2016).)

The extant research on charter schools has used multiple methods to account for this potential selection bias. The chosen method varies depending on the outcome being measured and the type of data available.[3] Ideally, researchers would be able to select students and randomly assign them to a charter school or a traditional public school and then observe the differences in outcomes. However, that is not possible. The next best real-world alternative is referred to as a lottery-style research design. This research design takes advantage of the random selection that an attendance lottery provides in oversubscribed charter schools. Researchers can address selection bias by comparing the performance of

[3] An excellent survey of the academic literature on charter schools and the various statistical methods used to correct for selection bias was recently conducted by Epple et al. (2015). They identified five methods used to correct for this potential bias: 1) fixed effect approaches, 2) a random lottery design, 3) matching procedures, 4) an ordinary least squares regression design and 5) instrumental variable approaches.

students chosen for the charter school to that of students not chosen (and who consequently attend a traditional public school). Thus, the comparisons of student outcomes only take place among individuals who wanted to attend that school, and as both groups are presumably similarly motivated, any difference can be attributed to the effect of attending the charter school. Lottery-style studies are not always practical, particularly if the schools of interest are not oversubscribed or lottery results are not available, as is the case for our study.[4]

Another approach to address selection bias is to use longitudinal pretreatment measures, usually test scores, when examining academic achievement. As students take tests repeatedly over many years, the change in test scores for individual students who move between traditional public schools and charters can be used to infer the impact of charter school attendance on student achievement. As individual student outcomes are observed, important student and family characteristics are controlled for. The validity of this method has recently been demonstrated by Furgeson et al. (2012) and Tuttle et al. (2013). This approach is also not possible for our study because we focus on long-term outcomes, which are one-time events after charter school enrollment.

Researchers have been confronted with these empirical limitations before and have devised a method to deal with them. To create a comparison group, they rely on students who attended a charter school in the eighth grade. The expectation is that this group of students will be similar in terms of unobserved family and student characteristics that would also be present in those who enroll in charter high schools (Booker et al. 2010; Sass et al. 2016).

The treatment students in this type of analysis remain enrolled in charter schools in ninth grade, whereas the control students attend traditional public schools for high school. This type of analysis also addresses selection bias by controlling for baseline student demographics and measures of ability, including eighth-grade test scores. Finally, a matching protocol is used to further control for unobserved characteristics and selection bias. A one-to-one nearest-neighbor covariate matching approach is used in which students in the treatment group are matched based on observable characteristics with a student who attended a traditional public high school in ninth grade.

This matched average treatment effects model is similar to that used in other studies (Booker et al. 2010; Sass et al. 2016). In our analysis, the students who attended a start-up charter in eighth grade represent the group of potentially studied students. The students who also attended a start-up charter in ninth grade are the treated group, and the students who remain (attending a traditional public high school or conversion charter school) are the potential matched control group students. Any effect found is between students and families who were all interested in and attended a charter school. The matching process ensures that the groups of students compared are similar in all possible ways except for charter

[4] Additionally, oversubscribed schools often are the top-performing schools, so results may not be applicable to all charter schools.

high school attendance. We also perform several robustness checks to test the importance of the student-level matching criteria.[5]

Summary Statistics

GA•AWARDS provides comprehensive data on all students enrolled in Georgia's public education system as well as their placement in the workforce. This dataset includes where individual students attended eighth and ninth grade and their workforce information years later. Table 1 shows the relevant number of eighth-grade cohorts by type of school based on information in the GA•AWARDS data set. The table also includes the date each cohort reached various academic milestones, such as high school graduation. There has been considerable growth in the size of start-up charter school eighth-grade cohorts from school year 2006-07 to 2011-12. In 2006-07, there were 835 eighth-grade students in start-up charter schools; by 2011-12, there were 3,339.

Table 1. Student Enrollment and Milestone Attainment Dates

8TH GRADE COHORTS*				ON-TIME EDUCATIONAL ATTAINMENT		
SCHOOL YEAR	CONVERSION CHARTER	START-UP CHARTER	TRADITIONAL PUBLIC SCHOOL	HIGH SCHOOL GRADUATION CLASS	BACHELOR'S DEGREE – SPRING	WAGES SUMMER**
2006-07	1,892	835	129,270	2011	2015	2015
2007-08	1,758	1,337	126,528	2012	2016	2016
2008-09	1,782	1,473	125,321	2013	2017	2017
2009-10	1,898	2,425	126,395	2014	2018	2018
2010-11	1,861	2,084	125,383	2015	2019	2019
2011-12	1,954	3,339	129,160	2016	2020	2020

*Non-duplicated student count of eighth grade students

**If an eighth grader completed high school and a bachelor's degree, both within four years, they could start working with a four-year degree the summer of this year.

Source: GA•AWARDS data

By comparison, there was not much growth in the eighth-grade conversion charter school attendance or in traditional public school eighth-grade attendance over the same period. For the school year 2006-07, there were 1,892 eighth graders enrolled 129,270 eighth-graders were enrolled in school year 2006-07, and 129,160 enrolled in 2011-12.

For this study, we are only interested in the eighth graders who attended start-up charter schools. As the GA•AWARDS dataset starts with the full calendar year 2007 and ends with calendar year 2016, it contains a limited number of observations for those eighth-grade cohorts that graduate college and enter the

[5] The small number of start-up charter high schools has been an issue in previous research. However, due to the Georgia Cyber Academy, students who do not have a bricks-and-mortar charter high school close by now have the option of attending a charter high school. The effects of including the Georgia Cyber Academy in our study as a start-up charter school are discussed later in the report.

workforce. Even if we assume optimistically that the relevant academic milestones are achieved on time, such as an eighth-grader completing high school in four years, enrolling in college and receiving a degree four years later, we are limited to the eighth-grade cohorts of 2007 and 2008 to observe data on wages post-college graduation. Only the 2007 cohort would have more than two quarters of wage data. Thus, we primarily focus on other academic milestones linked to future wage outcomes, such as high school graduation, college enrollment and college persistence. We have three to five cohorts of eighth graders for whom we can track these milestones. As more data become available over time, direct wage comparisons will be possible.

. . . we primarily focus on other academic milestones linked to future wage outcomes, such as high school graduation, college enrollment and college persistence.

Table 2 shows the number of eighth-grade students in the treatment and control group cohorts. The treatment group cohorts are composed of students who were enrolled in eighth grade in a start-up charter school and were enrolled in a start-up charter school in ninth-grade. The control group is made up of students who were enrolled in a start-up charter school in eighth grade but then were enrolled in a traditional public school or conversion charter school for ninth grade. The table tracks the relevant cohorts as they reach various academic milestones.

Table 2. Treatment and Control Cohorts and Milestones Attained

TOTAL COUNT		
8TH GRADE COHORT	CONTROL*	TREATMENT**
2007	694	141
2008	1,223	114
2009	1,263	210
2010	1,976	449
2011	1,372	712
2012	2,267	1,072
HIGH SCHOOL GRADUATION WITHIN 5 YEARS		
8TH GRADE COHORT	CONTROL*	TREATMENT**
2007	439	91
2008	604	71
2009	707	144
2010	975	250
2011	943	500
2012	1,281	603
2 CONSECUTIVE SEMESTERS OF COLLEGE WITHIN 7 YEARS		
8TH GRADE COHORT	CONTROL*	TREATMENT**
2007	370	80
2008	503	60
2009	556	119
2010	769	200
2011	720	370

*Control are eighth grade start-up charter school students who go on to attend a traditional public school or conversion charter school for ninth grade.

**Treatment are eighth grade start-up charter school students that go on to attend a start-up charter high school for ninth grade.

Source: GA•AWARDS data

Table 2 shows that in both the treatment and control groups sizeable shares of students fail to reach various academic milestones. For instance, of the 694 students in the 2007 control cohort, only 439 of them graduated from high school within five years (63 percent), and only 370 (53 percent) enrolled in college and persisted for two consecutive semesters within seven years of being in eighth grade. These failure rates are similar in the treatment group of 141 students in the 2007 cohort: only 91 graduated from high school within five years (65 percent), and only 80 enrolled in college within seven years of being in eighth grade (57 percent). The magnitude of the failure rates is similar for the later cohorts, even as the number of students grows.

The treatment cohorts from 2007 to 2009 have limited observations, with most of these students coming from four schools: Baconton Community School; College, Careers, Arts and Technology (CCAT) School; Fulton Science Academy High School; and Lanier Career Academy. For instance, in the 2007 treatment cohort, 118 of the 168 students came from the four schools listed above. These four schools also are where most of the treatment students went to school in eighth grade (see Appendix for more details).

Table 3 shows the mean value for the various academic achievement and demographic characteristics of the treatment and control groups, after matching. The standardized mean difference indicates that we have good balance in our matches. The last column in the table shows the standardized mean difference before matching.[6] This column shows the difference in the treatment population compared to all potential control candidates. Recall that potential control students are those that attended a start-up charter school for eighth grade but went on to a TPS high school for ninth grade. We briefly discuss these differences to illustrate the importance of the matching protocol to minimize bias as well as to highlight potential systemic differences between the treatment and control populations that require additional levels of inquiry.

Table 3. Summary Statistics for Treatment and Control Cohorts*

	TREATMENT AND CONTROL MEANS – AFTER MATCHING		STANDARDIZED PERCENT DIFFERENCE IN MEANS**	
8TH GRADE MEANS	TREATMENT COHORT	CONTROL COHORT	AFTER MATCHING	BEFORE MATCHING
English Score	839.83	840.83	-0.51%	-3%
Math Score	792.29	779.70	0.08%	10%
Reading Score	838.85	838.32	0.15%	2%
Free Lunch	61%	54%	-0.32%	14%
Gifted	3%	11%	0.00%	-31%
Limited English Proficient	2%	2%	0.00%	-4%
Disabled	9%	8%	0.14%	2%
Black	47%	53%	0.32%	-12%
Hispanic	3%	7%	-1.43%	-20%
White	45%	34%	0.08%	23%

*All students attended a start-up charter school in eighth grade. The treatment cohort are those students who went on to a start-up charter high school for ninth grade. The control cohort went on to a traditional public school or conversion charter high school for ninth grade.

**Standardized percent difference takes into account the standard deviation of the means.

Source: GA•AWARDS data and author's calculations

The academic achievement measures, except for the math score, are fairly close before matching. The pool of potential control students on average scored 10 percent lower than the treatment students on

[6] Standardized mean differences are the difference between two observed averages after accounting for the variance in the underlying data used to compute the averages.

the Georgia math Criterion-Referenced Competency Test (CRCT). On average, the treatment group appears to have lower family incomes than the potential control group, with 14 percent more treatment students receiving free or reduced-price lunch than the potential control group. We note that the treatment group has a lower share of black and Hispanic students and a higher share of white students than the potential control group. For these demographic and achievement metrics, there does not seem to be any systematic pattern that would cause problems for the matching protocol. Finally, the treatment group had a 31 percent lower share of students participating in the statewide gifted program than the pool of potential control students. This difference is largely due to schools not opting to participate in the gifted programs, which have many treatment students. The nearest-neighbor matching protocol allows for this difference as any student described as "gifted" is matched to another "gifted" student for the analysis.

Model Specification and Results

In this section, we describe our modeling specification. As discussed earlier, our treatment group consists of students who attended a charter middle school for eighth grade and then a charter high school for ninth grade. The control group attended a charter middle school for eighth grade and then a traditional public high school for ninth grade. Note that our classification is determined only by ninth grade high school attendance and is not affected by whether the student continues on at the charter school for grades 10-12. This choice was made to avoid problems of selection bias associated with students transferring out of the treatment group. Thus, the estimates of charter high school effects are similar to "intent to treat" impact estimates, where treatment is completing high school at a start-up charter high school (by entering ninth grade in a start-up charter high school, students intend to receive the full treatment).

To further control for endogeneity, we follow a matching approach used in previous studies (Booker et al. 2011, Sass et al. 2016). We use a one-to-one nearest-neighbor covariate match in which observable characteristics from the treatment group (start-up charter ninth-grade enrollment) are matched with students attending traditional public high schools to create a control group.[7] We then examine the difference in student outcomes between those in treatment relative to this counterfactual control group.

The causal nature of our treatment relies on an important assertion. The statistical process estimates the difference in the mean value of the outcome of interest for the treatment and control groups, for instance, the likelihood of high school graduation. For the treatment to have a causal relationship to any observed difference, the observable characteristics must be sufficient to make the counterfactual outcome — choosing to attend a traditional public high school — independent of the milestone of interest. To satisfy this condition, we choose only students who had enrolled in a charter school for eighth grade. Put another way, the model can be deemed causal only if upon leaving the charter school after

[7] This matching protocol is implemented in Stata using the *teffects nnmatch* routine. Robust standard errors are used as recommended by Abadie and Imbens (2006) for this type of matching protocol.

eighth grade, a student's chance of graduating from high school is independent of their choice to attend a traditional public school, controlling for the observable characteristics using the matching process. For a technical discussion of these criteria, see Smith and Todd (2001). We later conduct a sensitivity analysis using modifications to both the treatment and control groups for the matching analysis approach to provide further evidence of the robustness of our results.

RESULTS

Table 4 presents the estimated impacts of charter high schools on students' subsequent achievement of three academic milestones: high school graduation, college entry and college persistence. For the analysis, we match on student demographics, inclusion in the English as a second language program (ESOL), special education program participation, and family income (proxied by free/reduced-price lunch status).[8] In addition, we include both student ability and prior educational attainment by matching on eighth-grade math, reading and English test scores.[9]

Table 4. Estimates of the Effect of Attending a Charter High School on Educational Attainment

	HIGH SCHOOL DIPLOMA	COLLEGE EVER	COLLEGE PERSISTENCE	COLLEGE DEGREE OR CERTIFICATE
Start-up Charter Ninth Grade	0.0421***	0.0582***	0.0756***	0.0229*
	(0.0148)	(0.0191)	(0.0236)	(0.0125)
Observations	5,072	3,024	1,692	1,692

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: GA•AWARDS data and author's calculations

Table 4 shows estimates of the relationship between charter high school attendance and the probabilities of earning a standard high school diploma within five years of entering the ninth grade, enrolling in college within seven years, persisting in college, and earning a college degree or certificate. Our results are similar to those found in the recent literature (Booker et al. 2011; Sass et al. 2016), but the effects are generally smaller. We find that charter high school enrollment is positively associated with educational attainment and is statistically significant. The small positive coefficient in Column 1 indicates that attending a charter high school increases the likelihood of graduating from high school by 4.2 percentage points. Column 2 shows that those

. . . those attending a charter high school are 5.8 percentage points more likely to attend a two- or four-year college . . .

[8] English language skills are measured by participation in an English as a second language program.

[9] For test scores, we use the student's eighth-grade Georgia CRCT scores in reading, math and English. Note that the CRCT was retired after the 2013-14 school year and was replaced by the Georgia Milestones Assessment System beginning with the 2014-15 school year.

attending a charter high school are 5.8 percentage points more likely to attend a two- or four-year college than the control group.[10]

Column 3 shows results for persistence in college. We define persistence as attending college for two or more consecutive academic semesters following initial college entry. The estimated relationship between charter high school attendance and college persistence is positive and statistically significant. Our result of a 7.6 percentage increase in the likelihood of persistence in college is smaller than that found by Sass et al. (2016), which was a 12-percentage-point greater likelihood for charter high school students.

. . . students who attend charter high schools are slightly more likely to earn a college degree or certificate.

Finally, Column 4 shows that students who attend charter high schools are slightly more likely to earn a college degree or certificate. The result is positive and statistically significant but only at the 10 percent level. This smaller size and significance of this result compared to our other findings could be either due to fewer available observations to test this effect or a weaker effect of attending a start-up charter in ninth grade.

ROBUSTNESS

While our results are similar to those found in the literature, it is important to test their robustness to various changes in the composition of the treatment and control groups as well as changes in the matching criteria used in the model. The composition of our treatment and control group might insert bias into our estimation results in a few ways. The first concern is that many students in the treatment group come from charter schools that include middle and high school grades. The students do not transition from one middle school to different high school. Thus, it is possible that the effect being measured is partially due to the potential benefit of not having to change schools between eighth and ninth grade. This is a concern found in the literature generally (see Sass et al. (2016)).

To test the potential transition effect, we split our treatment group into two subsamples: those who change schools from eighth to ninth grade (the transition group) and those who did not (the nontransition group). We find that our results generally persist when the model is run on either treatment group with the control group being those students who went to a traditional public school for ninth grade. Table 5 shows our results. For the treatment group (made up of only the transition group), we find positive and statistically significant coefficients for high school graduation of 0.041 and college attendance of 0.072. These effects are similar in size to our results using the full sample but are statistically significant at only the 10 percent level. This decrease in statistical power is likely due to the smaller sample size. The coefficient on college persistence is also positive but not statistically significant. Again, this may be due to a smaller sample size.

[10] A small percentage of students in the relevant cohorts were dual-enrolled high school students. They are not included in the assessment of ever attending college, because they were still in high school.

Table 5. Robustness Tests Results

TREATMENT GROUP	HIGH SCHOOL DIPLOMA	COLLEGE EVER	COLLEGE PERSISTENCE
Transitioning Students	0.0410*	0.0723**	0.0281
	(0.0228)	(0.0304	(0.0389)
Non-Transitioning Students	0.0491***	0.0444*	0.0843***
	(0.0176)	(0.023)	(0.0284)
Treatment Groups Only	0.0312	0.0722*	-0.0126
	(0.0261)	(0.0387)	(0.0534)
Georgia Cyber Academy Excluded	0.0827***	0.116***	0.0938***
	(0.0169)	(0.0214)	(0.0253)

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source: GA•AWARDS data and author's calculations

The results from the treatment sample of nontransition students are again similar to the results from the full sample model in Table 4. The coefficient for high school graduation is 0.049 and statistically significant at the 0.01 percent level. The coefficient on college attendance is 0.044 and statistically significant at 10 percent level, and the coefficient on college persistence 0.084 and statistically significant at the 0.01 percent level. The lower level of statistical significance on the college attendance coefficient is somewhat puzzling given the strong statistical significance of the high school graduation and college persistence coefficients, but it could be related to the smaller sample sizes.

A second concern is that the two groups differ systematically in some unobserved way when compared directly to each other for our outcomes of interest. To test this, we compare the two subsamples to each other using the transition group as our treatment group and the nontransition group as the control. In this case, both treatment and control students attended eighth and ninth grade at a start-up charter. For high school graduation, we find a positive but not statistically significant coefficient of 0.031 for the transition group compared to the nontransition group. The average treatment effect of 0.072 college attendance coefficient is positive and statistically significant at a low 10 percent level. This suggests that students who change schools from eighth to ninth grade are roughly 7.2 percentage points more likely to attend college than those who did not change schools. The coefficient on college persistence is small and negative but not statistically significant.

This robustness check provides evidence that the two subsamples, within our original treatment group, do not differ for high school graduation or college persistence.

This robustness check provides evidence that the two subsamples, within our original treatment group, do not differ for high school graduation or college persistence. If our positive findings were being driven by the positive effect of not

transitioning schools from eighth to ninth grade, these two groups would be statistically different from one another for our outcomes of interest. Thus, it is unlikely that the two groups differ systematically in some unobserved way that is influencing our positive findings. This robustness test also indicates that if the results in our preferred specification are being affected by our treatment group not transitioning schools between eighth and ninth grade, the influence is working against our positive findings. While the evidence is weak, the group of students who changed schools were more likely to have positive outcomes compared to those who did not, the opposite of what would be the case if not transitioning were a benefit.

. . . attending a charter high school has a positive effect on high school graduation, college attendance, persistence in college and receiving a college diploma or certificate in Georgia.

A third concern is that the large student body of the Odyssey School, which includes the Georgia Cyber Academy, could be biasing our main results.[11] The school included 1,176 ninth-grade students for the treatment group (those who attended charter school in ninth grade) and 1,741 students for the control group (those who attended public school for ninth grade, see Appendix). To test the effect that Odyssey might have on our results, we ran the model but excluded all Odyssey students from both the treatment and control groups. Table 5 shows the results. The coefficient for high school graduation is 0.083, the coefficient on college attendance is 0.012, and the coefficient on college persistence is 0.094, all statistically significant at the 0.01 percent level. These coefficients are larger than for the full sample model, suggesting that if the large cyber academy is influencing our results, it is diminishing the strength of the positive effects of attending a start-up charter high school for ninth grade.

As our results show, attending a charter high school has a positive effect on high school graduation, college attendance, persistence in college and receiving a college diploma or certificate in Georgia. Due to data limitations, we were unable to test the effects that attending a charter high school has on wages. As more data become available through GA•AWARDS, we hope to be able to be able to answer that question for Georgia. While we are unable to make a direct connection to charter school student wages at this time due to data limitations, if charter school students in Georgia are more likely to earn a college degree, one can reasonably conclude that they are more likely to earn higher wages than their peers who attended traditional public schools.

Other types of studies have found a correlation between improved academic outcomes and earnings in the workforce. It is important to note that these studies produce simple bi-variate correlations and thus do not control for other factors. According to the U.S. Bureau of Labor Statics (BLS), high school graduates

[11] Until July 1, 2014, the Odyssey School was in a partnership with K12, Inc. to operate the Georgia Cyber Academy (GCA). As of the 2014-15 school year, the bricks-and-mortar Odyssey School served about 400 students in grades K-8, while GCA served roughly 13,000 students across Georgia. Over the years, this arrangement between Odyssey and GCA has made it difficult for the Georgia Department of Education to track the students in either school. However, because our study focuses on attending a charter high school, this is less of a problem as Odyssey does not serve high school students.

report lower unemployment rates and have higher median earnings than those without a high school degree. The national median weekly earnings for workers with a high school diploma were $668 in 2014 compared to $488 for those with less than a high school diploma. College-educated workers had higher wages still, with the size of the difference depending on the degree earned. For those with a bachelor's degree, the national median weekly wage in 2014 was $1,101 compared to $761 for those with an associate's degree. Note that these results do not consider other factors that might affect earnings, such as ability, age, gender, race/ethnicity and health. (For a more thorough discussion of this topic, see Bluestone et al. (2016).)

Several other benefits can be linked to reaching various academic milestones. Higher incomes result in lower spending on social assistance, which could benefit state and local governments. For instance, in 2012, the BLS estimated that nationally, benefits received by individuals in income groups that are comparable to the earnings of workers without a high school degree averaged $1,040 per year. Public assistance for higher wage earners averaged $385 per year in 2012.[12]

Another benefit of higher graduation rates is lower incarceration rates (Dobbie and Fryer 2013). According to the Georgia Department of Corrections, the annual average cost per inmate totaled roughly $20,000 in 2015. Again, this is a benefit that would accrue mostly to state and local governments. Lower rates of incarceration would suggest that fewer crimes are being committed. Lower crime rates would benefit communities. These benefits are harder to quantify but can be substantial. For instance, Heckman et al. (2010) estimates that the benefits to society from the reduction in crime associated with successful early childhood interventions for disadvantaged urban children account for 41 to 66 percent of the program benefits when expressed as an annual rate of return.[13] (For a thorough discussion of the difficulties in estimating these benefits see, Heckman et al. 2010.)

Conclusion

This report, the third in a series on the economic impact of start-up charter schools in Georgia, provides further evidence that start-up charter schools are having a positive economic impact on the students who attend them and their communities. We find that attending a Georgia charter high school increases the likelihood of high school graduation by roughly 4 percentage points, and such students are 6 percentage points more likely to enroll in college than comparison groups of students who attended charter middle schools but then went to traditional public high schools. Once in college, charter high school students are about 8 percentage points more likely to persist for two consecutive semesters and 2 percentage points more likely to earn a college degree or certificate than the students who attended traditional public high schools.

[12] These benefits included public assistance, supplemental security income and food stamps, which are predominantly federal programs.

[13] This variation is due to assumptions made in the value of statistical life due to declines in the murder rate.

These results provide evidence that charter schools improve academic outcomes later in life. The increased likelihood of college graduation and earning a degree or certificate suggests that charter high schools are imparting some additional skills to students, rather than just successfully coaching them to high school graduation and then helping them enroll in college.

These results lead to additional questions for research. As was discussed earlier, charter schools in Georgia have shown mixed results in improving students' test scores (Sass 2015). Some scholars attempting to identify the skills and qualities imparted to students by charter high schools claim that such schools can teach hard-to-measure qualities such as grit, persistence, self-control and conscientiousness. While these skills are not fully captured in test scores, they are important in achieving long-term outcomes. (See, for instance, Duckworth and Allred (2012).)

These results provide evidence that charter schools improve academic outcomes later in life. The increased likelihood of college graduation and earning a degree or certificate suggests that charter high schools are imparting some additional skills to students, rather than just successfully coaching them to high school graduation and then helping them enroll in college.

Additional research is needed to determine how and why Georgia start-up charter schools are improving life outcomes for their students. Bluestone et al. (2016) categorized the educational pedagogy of 50 Georgia start-up charter schools to identify those that use No Excuses methods. Building on this work, using future GA•AWARDS data would allow us to test the effects of attending a No Excuses charter school on achievement and later life outcomes. Additionally, the inclusion of several future cohort years of GA•AWARDS data also would allow us to directly test the effects of charter high school on wages.

Another potential extension of this research would be to identify the effects of attending charter schools on students who leave high school but do not enter the labor force. Merging data available to the Center for State and Local Finance on recipients of the Temporary Assistance for Needy Families (TANF) program and the Supplemental Nutrition Assistance Program (SNAP) would allow researchers to better understand how charter school attendance effects participation in these federal programs.

This research joins a small group of studies that look at broader outcomes such as graduation rates and adds Georgia charter schools to a list of studied localities that previously included only Chicago, New York, Boston and Florida. Our findings are significant as there is an earnings premium associated with reaching the various milestones we assess. For instance, BLS estimates that high school graduates earn almost $200 more per week than non-graduates and college graduates earn $433 more per week than those with only high school diplomas. These additional earnings provide an economic impact to the communities in which they are spent. In addition, increased wages associated with high school graduation

and college enrollment can be linked to lower social programs as well as lower rates of incarceration, which can benefit state and local governments. As this report, as well as the previous reports demonstrate, start-up charter schools do have meaningful economic impacts on the individuals that attend them as well as their communities in Georgia.

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Appendix. Selected Charter Schools with Enrollment by Source School

		9TH GRADE STUDENT ENROLLMENT		
SOURCE SCHOOL	8TH GRADE ENROLLMENT	NON-START-UP CHARTER	START-UP CHARTER	SAME SCHOOL AS 8TH GRADE
Amana Academy School	121	58	63	0
Atlanta Charter Middle School	224	196	28	0
Baconton Community Charter School	582	52	265	265
Brighten Academy	183	182	1	0
CCAT School	230	45	93	92
Challenge Charter Academy	126	68	32	26
Charles R. Drew Charter School	512	466	46	0
DeKalb Academy of Tech	155	154	1	0
DeKalb Path Academy	354	351	3	0
Elite Scholars Academy School	411	66	173	172
Fulton Science Academy	877	650	114	113
Fulton Science Academy High School	0	N/A	197	0
Georgia Connections Academy	173	71	57	45
Hapeville Charter Career Academy	0	N/A	207	0
Hapeville Charter Middle School	1,092	656	319	117
Imagine International	210	207	3	0
Imagine Wesley	66	61	5	0
International Academy	122	120	2	0
Ivy Preparatory Academy School	140	127	13	0
KidsPeace	71	36	18	17
KIPP Atlanta Collegiate	0	N/A	141	0
KIPP South Fulton	285	212	73	0
KIPP West Atlanta	347	215	132	0
Lanier Career Academy	267	144	64	59
Odyssey School/GA Cyber Academy	3,999	1,741	1,176	1,082
Oglethorpe Charter	722	720	2	0
Tech High School	0	N/A	106	0
University Charter	279	247	32	0

Source: GA•AWARDS data and author's calculations

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Peter Bluestone is a senior research associate with the Center for State and Local Finance. His research includes urban economics, static and dynamic economic impact modeling, and state and local fiscal policy. His work includes modeling state and local impacts of policy changes and economic development using various economic models, including IMPLAN and Regional Economics Models Incorporated (REMI). Bluestone currently serves on the technical advisory committee for the Atlanta Regional Commission. He received his doctorate in economics from Georgia State University.

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While the Commission's duties are set forth in law and extend beyond simply authorizing schools, the Commission's principal obligations include:

- Reviewing charter school petitions for commission charter schools and assisting in the establishment of commission charter schools throughout Georgia;
- Developing and promoting best practices for charter schools and charter school cosponsors to ensure that high-quality charter schools are developed and encouraged;
- Promoting high standards of accountability for commission charter schools; and
- Monitoring and annually reviewing the academic and financial performance, including revenues and expenditures, of commission charter schools and holding the schools accountable for their performance pursuant to the charter.