LESSONS FROM CHARTER SCHOOLS: WHAT MAKES A HIGH QUALITY SCHOOL?

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A dissertation submitted to the faculty of the University of North Carolina at Chapel Hill in partial fulfillment of the requirements for the degree of Doctor of Philosophy in the Department of Public Policy.

Chapel Hill
2016

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ABSTRACT

Lisa Spees: Lessons from Charter Schools: What Makes a High Quality School?
(Under the direction of Krista M. Perreira)

This dissertation evaluates the differences between charter schools and traditional public schools and how these differences influence teachers and students. The first essay examines different methods for evaluating student achievement in charter schools and traditional public schools and the difficulties in disentangling the effect of charter schools from unobservable student background characteristics. In the second essay, I evaluate whether charter schools are influencing student's non-cognitive abilities. Specifically, I determine whether attending charter schools affects students' number of absences, tardies, and suspensions. Finally, the third essay examines whether charter schools are attracting and retaining more effective teachers than traditional public schools. In sum, this three essay dissertation provides valuable information to policymakers and educators on how local and state charter school policies and contexts are influencing teachers and students.

ACKNOWLEDGMENTS

I would like to thank Krista Perreira, my dissertation chair and graduate advisor, for the guidance and mentorship she has provided since the beginning of graduate school. She has given me with the skills and experience I need to be a successful and effective researcher. I also want to thank the rest of my dissertation committee, Dougles Lauen, Steve Hemelt, Sudhanshu Handa, and Ted Mouw for helping me think through my dissertation and writing struggles and for providing encouragement and advice throughout the process of writing my dissertation.

I am also grateful for the support of the Carolina Population Center. Working at the Carolina Population Center (CPC) helped develop my passion for demography, health disparities, and education inequalities. The personnel at the CPC provided me with invaluable assistance in statistics, technical and IT support, presentation design, etc. I also want to thank my friends and colleagues Stephanie Potochnick, Kathleen Wirth, Yuna Kim, and Evan Johnson for helping me navigate and complete the steps and hurdles one faces as a doctoral student.

Lastly, I want to thank my family and friends who have supported me through this endeavor. Thank you to my brother, Matthew, and my parents, JoEllen and David, for their patience and support. I also want to thank my best friends and North Carolina family, Katherine and Rick, who have supported me throughout graduate school and were always willing to help take my mind off of my work, whether it be through a friendly tennis match or walk around the neighborhood.

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CHAPTER 1: INTRODUCTION

The idea of school choice was developed in the 1950s by economist Milton Friedman. Friedman believed that poor student performance resulted from forcing schools to be democratic institutions. He argued that the government should fund the U.S. school system but not retain control over schools. In other words, the government should abandon the rules and regulations restricting traditional public schools (TPSs). Instead, Friedman proposed that school choice would fix the public school system because it would allow students to attend their chosen school and lead to a variety of new schools. Friedman predicted that vouchers would encourage the development and improvement of schools through market competition. Thus, Friedman claimed, school vouchers would not only increase student achievement but also force complacent and failing public schools to improve. Otherwise, these TPSs would be in danger of losing their best and brightest students. From Friedman's perspective, school choice could only increase student achievement or, at worst, maintain student achievement levels.

While Milton Friedman developed the idea of school choice, it did not become a popular policy solution until John Chubb's and Terry Moe's *Politics, Markets, and America's Schools.* This classic study analyzed 1980s educational reforms and concluded that low student performance should not be blamed on schools. Similar to Friedman, Chubb and Moe believed school choice would increase competition among schools, and in turn, this competition would increase all students' academic achievement. Since Chubb and Moe first published their study in

1990, charter schools, a form of school choice, have become an increasingly popular alternative to TPSs.

This dissertation evaluates the differences between charter schools and traditional public schools (TPSs) and how these differences influence teachers and students. The first essay evaluates student achievement in charter schools and TPSs and suggests that causal claims about the effect of charter schools on student achievement may be unwarranted. In the second essay, I look beyond student achievement and extend my analysis to evaluate whether charter schools are influencing student's behavioral outcomes. Specifically, I determine whether attending charter schools affects students' number of absences, tardies, in-school suspensions, and out-of-school suspensions. Interestingly, while the findings on student achievement are complex and show evidence of causal heterogeneity, my results regarding charter schools influence on student behavioral outcomes are more straightforward; overall, attending a charter school is associated with better behavioral outcomes. Finally, the third essay examines whether charter schools are attracting and retaining more effective teachers than traditional public schools. In sum, this three essay dissertation provides valuable information to policymakers and educators on how local and state charter school policies and contexts are influencing teachers and students.

Essay One

Past research shows that North Carolina charter schools have a negative effect on student achievement. Disentangling the effects of charter schools from background student characteristics is complex and makes it difficult to support causal claims. Results from this study demonstrate how different estimation methods lead to different and even opposing conclusions. Student fixed effects models showed charter schools have a large negative effect on student achievement. Student random effects models estimated no effect of charter schools in math

achievement and a small, positive effect in reading achievement. Lastly, I demonstrate that, using multilevel growth models, charter schools have a positive effect on both math and reading achievement. Finally, examining different subpopulations of charter school students and of switchers demonstrates the prevalence of selection bias in estimating charter school effects. These findings suggest that causal claims about the effects of charter schools on achievement may be undeserved.

Essay Two

While results regarding the effects of charter schools on student achievement have been, overall, inconclusive, little research has examined the effects of charter schools on behavioral outcomes despite their importance in determining students' future success. This study examines whether charter schools influence students' behavioral outcomes and uses data from 2006 to 2009 in North Carolina. The results show that relative to charter school only students, switchers were negatively selected on a wide array of observable characteristics. Yet, charter school enrollment is associated with improved behavioral outcomes such as student absences, tardies, and suspensions, even after controlling for student demographic characteristics and student fixed effects. The positive, marginal association of charter schools increases as students remain in charter schools for longer periods of time.

Essay Three

There is mounting evidence that teachers are essential to increasing student achievement. However, young adults continue to feel ambivalent about joining the profession. Charter schools have become a popular alternative to TPSs and are touted as the ideal solution to fixing the US education system. Charter schools' alternative policies are key to attracting and retaining effective teachers since they simultaneously give teachers the flexibility to perfect their teaching

style while also providing school administrators with the ability to remove ineffective teachers and award effective teachers. This chapter examines whether charter schools are more likely to retain effective and high quality teachers than TPSs. Using data from North Carolina, I find that high-performing teachers, as measured by value added models, are more likely to remain in their schools than low quality teachers. Additionally, despite the significant differences in school characteristics among charter and TPSs, there is no difference between charter school and TPS teachers in terms of their movement among schools. In other words, charter schools are no better at retaining effective teachers than TPSs.

CHAPTER 2: THE COMPLEXITY OF ESTIMATING ACADEMIC ACHIEVEMENT IN CHARTER SCHOOLS: EVIDENCE FROM NORTH CAROLINA

Introduction

Since charter school legislation was first passed in 1991, charter schools have become a popular alternative to traditional public schools (TPSs). Currently, 42 states and the District of Columbia have adopted charter school legislation. From 1999 to 2013, the percent of students attending charter schools increased from .7 percent to 6.2 percent while the number of operating charter schools grew from approximately 1,500 to 6,100 (NCES, 2015). These rates continue to increase each year.

Despite their popularity, charter schools' effects on student achievement remain inconclusive. Some studies conclude that charter schools decrease student achievement (Bifulco & Ladd, 2006; Carruthers, 2012; Hanushek et al., 2007; Imberman, 2011; Lauen, Fuller, & Dauter, 2015; Lavertu & Witte, 2009). In contrast, other studies find that charter schools increase student achievement. (Abdulkadiroglu et al, 2009; Berends, Mendiburo, & Nicotera, 2008; Booker et al., 2007; Hoxby & Rockoff, 2005; Hoxby & Murarka, 2009; Solmon & Goldschmidt, 2004; Solmon, Paark, & Garcia, 2001). Other researchers have reported that charter schools had no significant impact on student test scores (Witte et al., 2007; Zimmer et al., 2009).

This study estimates the effects of attending a charter school on North Carolina elementary and middle school students' math and reading test scores. I demonstrate the need to use caution when interpreting how charter schools affect student achievement due to the inherent differences among student entering and exiting charter schools. My analysis begins with

estimating a simple form of the education production function using a pooled Ordinary Least Squares (OLS) model, which allows me to control for potentially confounding student background characteristics. However, this model incorrectly assumes that the error term is independent across student observations. I build upon this model by employing a student fixed effects model, which is a commonly favored model when estimating charter school effects from observational, longitudinal data. Student fixed effects models provide the most internally valid estimates (except for experimental estimates) because they are based solely on within student variation. In other words, both observable and unobservable time-invariant characteristics are controlled. Its estimates, however, represent only a small, unique subgroup of the charter school population. Consequently, I employ student random effects and multilevel growth models (time nested within student), which take advantage of the longitudinal qualities of my data and take into account the correlation among students over time. These models base estimates on the entire TPS and charter school student samples. The growth models provide dramatically different findings from the student fixed effects models. Examining the descriptive characteristics of the different charter school subpopulations helps to explain these conflicting estimates. Using graphical interpretations of these models to compare subsamples of charter school students and TPS students demonstrates the inherent challenges faced when attempting to estimate the true effect of charter schools on student achievement.

The results raise important reservations about the causal status of the effect of charter schools on student test scores, an implication discussed more in the conclusion. My results also help explain why there have been a range of estimates when examining charter school student achievement. Finally, I discuss the implications my analysis has on policy and research design when estimating charter school effects.

Background

Theoretical Considerations

Charter schools are one of the many forms of school choice that decentralize public education. Unlike TPSs, students at charter schools do not have to reside in a certain district or neighborhood to be eligible to attend and are not subject to the same rules and regulations as TPSs, but the schools still receive public funding. Additionally, these schools can receive financial support from donors or other charitable organizations. Of course, charter schools must still follow some basic regulations in order to ensure that they increase student achievement (Henig, 2008).

Two major theories of action, local control and market forces, are used to explain why and how charter schools have the potential to improve the quality of the U.S. education system (Lubienski, 2003). The local control theory posits that giving local leaders, parents, and other community members control of their educational system allows schools to break away from the stifling and unproductive bureaucracy. Shifting the control of schools to local individuals makes them better able to effectively respond to the needs and demands of their community members; in other words, proponents of charter schools are "cultural relativists" that create schools to meet the specific needs of a particular community (Fuller et al., 2004). Of course, underlying the basic principles of local control theory is the assumption that all stakeholders' sense of mission will drive them to create and develop better schools. This is not always the case as past research has delineated between two types of charter school founders; there are those who are market-oriented and those who are mission-oriented (Henig et al., 2005).

Market theory, in contrast, posits that competition for clients drives organizations to provide quality products. When applied to the education system, market theory suggests that charter schools compete for students by providing a quality education since they cannot compete on price. Supporters of this theory propose that poor student performance results from forcing schools to be democratic, noncompetitive organizations (Chubb & Moe, 1990). In other words, the government's restrictive rules and regulations governing schools make them ineffective in providing a quality education. As a form of school choice, charter schools "stimulate the development and improvement" of schools through market competition (Friedman, 1962; Chubb & Moe, 1990). Again, this theory relies on the assumption that parents and other interested parties are receiving free and reliable information on the relative quality of schools.

Background on North Carolina Charter Schools

North Carolina adopted charter school legislation in 1996, with the first 34 charter schools opening for the 1997-1998 school year. After lifting the 100 charter school cap in 2011, the number of charter schools operating in North Carolina grew to 148 for the 2014-2015 school year. Additionally, charter school enrollment continues to increase each year while an additional 32,000 students remain waitlisted (NCDPI, 2015; NCAlliance, 2015).

Charter schools in North Carolina are exempt from following several operational and funding regulations governing TPSs. Instead, a charter school's board of directors is in charge of the budget, curriculum, and other operational activities. For example, the school board is not required to provide transportation or meals to students, even students in free and reduced lunch programs. Additionally, teachers at charter schools do not have to be licensed; fifty percent of middle and high school teachers can be unlicensed and 25 percent of elementary school teachers can be unlicensed. In terms of funding, charter schools receive the average per-pupil allocation

including additional funding for special needs and LEP students. However, charter schools are not eligible to receive capital funding and cannot use state funds to buy real property (Office of Charter Schools, 2015).

Past Literature on Charter School Student Achievement

Several studies have examined the effect of charter schools on student achievement, at the local, state, and national level. Results have, overall, been inconclusive. At the national level, one study including data from 26 states found that most charter schools did not significantly affect students' math achievement (40%) or reading achievement (56%), although two subgroups, LEP Latinos and black students from low socioeconomic backgrounds, greatly benefited from attending charter schools. Approximately equal numbers of charter school students had lower (31%) and higher (29%) test scores in math. Slightly more charter school students had lower test scores in reading (25% vs. 19%; CREDO, 2013).

Studies using lottery systems to estimate charter school effects in Chicago, New York City, and Boston have, overall, shown improvement in student test scores (Abdulkadiroglu et al., 2011; Hoxby & Murarka, 2009; Hoxby & Rockoff, 2005). When charter schools are oversubscribed, schools accept students based on a randomized lottery system. Using a lottery system provides strong internally valid results since students will be more adequately matched in terms of unobservable confounds. However, external validity is weakened since estimates are based only on students who want to attend charter schools (as opposed to all other students in TPSs).

Several charter school studies using longitudinal observational data employ student fixed effects models to estimate charter school effects (Bifulco & Ladd, 2006; Carruthers, 2012; Imberman, 2011; Lavertu & Witte, 2009; Sass, 2006; Zimmer et al., 2009). These estimates can

be considered causal, assuming that time-variant observables are included in the model, since the need to control for time-invariant observables and unobservables is eliminated. External validity, however, is a key issue since student fixed effects estimates are based solely on switchers, or students who switch from charter schools to TPSs and vice versa.

Among studies using student fixed effects models, results have been mixed. In Florida, Sass (2006) showed that charter schools have a negative effect on achievement. However, after their fifth year of operation, there was a significant positive effect on reading test scores. In Wisconsin, the opposite results were found using student fixed effects: charter schools had no effect on reading achievement but a positive effect on math achievement (Lavertu & Witte, 2009). These differences suggest that effects of charter schools may vary across school systems and states.

Recently, charter school studies have started using multilevel growth models, a type of student random effects model to estimate test score growth (Berends et al., 2009; Lauen, Fuller, & Dauter, 2015; Zimmer at al., 2009). These models allow for estimates to be based on the entire charter school and TPS student samples and build on student random effects models by permitting both random slopes and intercepts. At the same time, these studies continue to face non-random assignment issues and must control for both student time-variant and time-invariant confounds.

Studies using multilevel growth models have also found a variety of charter school effects. In an unknown urban school district, Berends and his colleagues (2008) found that charter schools increased test scores after an initial drop during students' first years in charter schools. In California, reading and math test score growth was lower in elementary charter schools than TPSs (Lauen, Fuller, & Dauter, 2015; Zimmer et al., 2009).

Past Literature on North Carolina Charter Schools Student Achievement

Two studies conducted in North Carolina found that charter schools on average lower student math and reading test scores. (Bifulco & Ladd, 2006; Carruthers, 2012). Bifulco and Ladd (2006) used data on students in North Carolina's public school system between the years of 1996 and 2002 in grades 3 through 8. Using levels, gains, and student fixed effects models, Bifulco and Ladd (2006) showed that charter school students' achievement was significantly lower than TPS student achievement. Charter school students' reading and math test scores were .095 and .160 of a standard deviation lower than TPSs when estimated using student fixed effects. Bifulco and Ladd (2006) suggest that their estimates using student fixed effects are representative of the larger charter school population by comparing students observed in both charter and TPSs to students observed at least once in a charter school and showing that they were demographically similar groups in terms of race and parent education.

Carruthers (2012) analyzed charter school effects in North Carolina from 1996 to 2002 in grades 7 and 8. Carruthers (2012) employed two versions of the student fixed effects model. In the first version, the outcome variable was students' standardized test scores, otherwise known as a levels dependent variable. This model determined that charter schools had a positive effect on both math and reading student test scores. The other version used a gains dependent variable, which represents the difference in students' test scores from one year to the next. In contrast to the levels model, the gains model shows a negative effect from charter schools on math achievement and a positive effect on reading achievement. Lastly, Carruthers (2012) employs a dynamic panel data (DPD) model which uses students' past test scores as an instrumental variable. Carruthers (2012) points out that the major issue with this model is that it limits her

analysis to a small sample of the data since students must have at least three lagged test scores to be included in the DPD model. Results show that math test scores are .016 of a standard deviation lower while reading test scores are .001 of a standard deviation higher in charter schools.

Data and Measures

Data

My sample includes elementary school and middle school TPS and charter school students in grades 4-8 between the years of 2004 and 2011. Approximately 3.9 million observations of 1.3 million students, including 44,000 charter school students, were included in my analytic sample.[1] My analysis focuses on the most recent data available in North Carolina. Previous research on North Carolina's charter schools used data up to 2002 (Bifulco & Ladd, 2006) and 2007 (Carruthers, 2012).

I used data from the North Carolina Department of Public Instruction (NCDPI) administrative records. These data are maintained by the North Carolina Education Research Data Center and includes information on all TPS and charter school students in grade 3 through 12 in North Carolina. Information on teachers, classrooms, schools, and districts are also available. Students are longitudinally linked and therefore can be followed from year to year.

To increase the internal validity of my results, the scores of students whose tests were incorrectly administered were omitted from analysis and replaced with their correctly administered test. Additionally, students with the same identification number in the same year were dropped since there was no basis for determining which identification number identified the correct student. To be kept in this analysis, students had to have at least one lagged test score to

[1]These statistics refer specifically to the math sample.

control for prior educational inputs. Therefore, students in grade 3 were omitted. Students with missing data on dependent or independent variables were dropped.

Measures

Achievement. My dependent variables of interest were students' end-of-grade (EOG) math and reading tests scores. From grades 3 to 8, all students are required to take math and reading multiple choice tests at the end of the school year to evaluate their academic competencies as described in the North Carolina *Standard Course of Study.* Scores should increase as students move through each grade. If students' scores do not improve, charter schools risk being shut down. To make scores comparable, students' raw scores are standardized (i.e. the mean becomes 0 and the standard deviation becomes 1) for each year and grade combination. Other indicators of achievement, such as college enrollment, are less suitable since it may not be one of the charter school's primary objectives.

Charter School Indicator. My main covariate of interest indicated if a student attended a charter school and is time-varying (1=yes, 0=no).

Additional Controls. Time-variant and -invariant covariates were included in my analysis. Time-invariant covariates included race and gender (male=0, female=1). Race consisted of five categories including black, Asian, Hispanic, Native American, and multiracial, with white being the reference category.

Time-variant covariates included dummy variables of LEP status, disability status, free or reduced price lunch, academic giftedness in math and reading, and retention. A student was considered learning disabled if he or she was labeled as having a deficiency in one of 4 areas: reading, writing, math, or other. Additionally, indicators of structural change and non-structural change, with no change being the reference category, were included. A structural move is

defined as a situation in which a student and at least 30 percent of those in his or her same grade and school move together to another school (Carruthers, 2012; Sass, 2006). In other words, a structural move is made if a student moves from elementary school to middle school. A non-structural move indicates if a student changed schools during elementary or during middle school. Lastly, models included grade and grade squared to control for time.

Methods

I begin my analysis by estimating a simple valued-added model (VAM) of the education production function. VAMs assume that prior inputs can be summarized by students' lagged test scores (Todd & Wolpin, 2003; Todd & Wolpin, 2007). This inherently introduces endogeneity bias into the model since prior inputs most likely influence current inputs.

The general model includes a once lagged test score, Y_{ti-1}, on the right hand side of the equation and is used instead of a gains score model, which places the lagged test score on the left hand side. Gains score models assume that the coefficient on lagged test scores is equal to one. In other words, this assumes that the lagged test score is a perfect representation of students' prior inputs and achievement and that there is no decay effect (Todd & Wolpin, 2003).

Using ordinary least squares (OLS), my model is:

$$(1)\ Y_{ti} = \beta_0 + \beta_1 Y_{ti-1} + \beta_2 \text{Charter}_{ti} + \beta_3 \text{Grade}_{ti} + \beta_4 \text{Grade}^2_{ti} + \beta_5 \mathbf{XT}_{ti} + \beta_6 \mathbf{X}_i + \varepsilon_{ti}.$$

This model regresses math or reading standardized test scores, Y, at time *t* for student *i* on a charter indicator, grade level, grade squared, once lagged achievement, a vector of time-variant covariates (**XT**), and time-invariant covariates (**X**). Pooled OLS models assume that the error term, ε_{ti}, is independent across observations. Additionally, to obtain accurate estimates, this

model assumes that all potentially confounding time-variant and time-invariant variables between the charter school indicator and the outcome variable, standardized math or reading test score, are included.

Student Fixed Effects Model

In most models estimating charter school effects, the main problem encountered is controlling for unobservable student confounds. Consequently, student fixed effects models are commonly employed, which controls for time-invariant unobservables, such as innate ability, and time-invariant observables:

$$(2)\ Y_{ti} = \beta_0 + \beta_1 Y_{ti-1} + \beta_2 \text{Charter}_{ti} + \beta_3 \text{Grade}_{ti} + \beta_4 \text{Grade}^2_{ti} + \beta_5 \mathbf{XT}_{ti} + \lambda_i + \varepsilon_{ti}$$

Student fixed effects allow each student to have his or her own deviation, λ_i, from the mean intercept, β_0; therefore, students are compared only to their own baseline. Using student fixed effects accounts for all student time-invariant confounds, such as innate ability and prior inputs, since only within student estimates are computed. Consequently, there is no need to control for both observed and unobserved time-invariant student confounds since students are only being compared to themselves. Unlike equation (1), equation (2) does not require a vector of time-invariant covariates, $\mathbf{X}_i$. These estimates, however, may still be biased due to time-variant covariates ($\mathbf{XT}_{ti}$), which continue to be included in the model.

The student fixed effects model is relatively inefficient (i.e. leads to larger standard errors) and requires within-student variation (about 2% of my sample) because student fixed effects estimates are only based on switchers. Consequently, this model has less external validity.

Student Random Effects

When using longitudinal data, OLS is found to be inefficient and biased. To take advantage of the longitudinal aspects of this data, I employ the more efficient student random effects model which allows for within unit correlations or the clustering of students' errors. Random effects models use precision-weighted least-squares estimates that compute both between effects and fixed effects and provide the weighted average of these two results:

$$(3)\ Y_{ti} = \beta_0 + \beta_1 Y_{ti-1} + \beta_2 Charter_{ti} + \beta_3 Grade_{ti} + \beta_4 Grade^2_{ti} + \beta_5 \mathbf{XT}_{ti} + \beta_6 \mathbf{X}_i + \varepsilon_{ti} + u_{0i}.$$

In this model, the additional term, u_{0i}, estimates a student's time-invariant error term while ε_{ti} accounts for a student's time-varying residual. In contrast to pooled OLS, student random effects allows each individual to have his or her own random intercept. Similar to the pooled OLS model, to obtain accurate estimates, all potentially confounding time-variant (**XT)** and time-invariant (**X**) covariates must be controlled.

Multilevel Growth Models

Lastly, non-linear multilevel (time nested within student) growth models, a type of random effects model, are estimated. Like other random effects models, both between and within variance are used to estimate effects which make this model more efficient than fixed effects models that only use within variance to estimate coefficients. Additionally, these models allow estimates for non-linear growth trajectories:

$$(4)\ Y_{ti} = \beta_0 + \beta_1 Charter_{ti} + \beta_2 \mathbf{XT}_{ti} + \beta_3 \mathbf{X}_i + \beta_4 Grade_{ti} + \beta_5 Grade^2_{ti} + \beta_6 Grade_{ti} \times Charter_{ti} + \beta_7 Grade^2_{ti} \times Charter_{ti} + u_{0i} + u_{1j} Grade_{ti} + u_{2j} Grade^2_{ti} + u_{3j} \mathbf{XT}_{ti} + u_{4j} \mathbf{X}_i + \varepsilon_{ti}$$

Both time-variant ($\mathbf{XT}_{ti}$) and time-invariant ($\mathbf{XT}_{i}$) covariates are included. Unlike the previously mentioned random effects model used, this multilevel growth model allows both slopes and intercepts to vary randomly. The time variable, Grade_{ti} (and consequently, Grade^2_{ti}), are set to 0 (instead of grade 4) to define initial status. β_6 is the coefficient of interest and demonstrates the average effect of attending a charter school on students' tests scores across all grade levels. I also include a squared time variable, Grade^2_{ti}, which allows the effects to be non-linear. By including this covariate, there is no assumption made that the average effect of attending a charter school must be the same across all grade levels.

Estimates are unbiased and efficient if the covariates are uncorrelated with attending a charter school; in other words, all possibly confounding variables are controlled so that attending a charter school is exogenously determined.

Comparing the effects of charter schools estimated from the student fixed effects model to the student random effects model leads to vastly different conclusions regarding charter schools. Using the preferred multilevel growth model since it allows both slopes and intercepts to vary as well as allows me to include both time-variant and time-invariant confounds helps to explain the these different findings. To further explore these results, I ran additional growth models on subsamples of charter school students. Specifically, I compare the growth trajectories among students observed only in TPSs to students observed only in charter schools, students who switched into charter schools, students who switched out of charter schools, and finally, students who switched schools multiple times.

Results

In general, charter schools seem to have slightly better characteristics than TPSs (Table 2.1). Charter schools enroll fewer students (352 vs. 545), have less crime per 100 students (.26 vs. .63), and are less likely to be a Title I School (42% vs. 62%). Similar proportions of white students (54%) attend each school type although a higher proportion of black students attend charter schools (37% vs. 31%) while a higher proportion of Latinos attend TPSs (10% vs. 4%). Finally, most charter schools are situated in urban areas (39%) while most TPSs are located in rural areas (48%).

Examining the descriptive statistics of my student sample among students observed only in TPSs, those observed only in charter schools, and switchers illustrates that students observed only in charter schools appear to have better more affluent characteristics compared to switchers (Table 2.2). Demographically, charter school students are more likely to be white (69% vs. 50%) and less likely to enroll in free or reduced price lunch programs (19% vs. 37%) than switchers. Switchers are more likely to be black (37% vs. 22%) and are more likely to be retained (2% vs. 1%). Switchers do not appear to represent the majority of charter school students.

Even among switchers, a few distinct trends differentiate students that switch into charter schools, switch out of charter schools, and switch multiple times (Table 2.3). Those who switch into charter schools are more likely to be white (61%). Multiple switchers and those switching out are more likely to enroll in a free or reduced price lunch program (50% and 40%, respectively), are more likely to be retained (3% and 2%, respectively), to have a disability (6% and 6%, respectively), and are less likely to be white (41% and 51%, respectively). Students selecting into charter schools have more affluent background characteristics when compared to multiple switchers and those switching out of charter schools.

The student fixed effects model estimates that charter schools have a large and statistically significant negative effect on math and reading test scores (Table 2.4).[2] Attending a charter school is associated with a .13 decrease in students' standardized math test scores and a .05 decrease in students' reading standardized test scores compared to TPS students. However, student fixed effects models only use switchers to compute estimates, and switchers represent approximately 2% of students and do not represent the majority of charter schools students.

For both the math and reading outcomes, the pooled OLS and student random effects models provide similar estimates (Table 2.4). For the math sample, charter schools have no significant effect on achievement in either the pooled OLS or student random effects model. For the reading sample, charter schools have the same positive and statistically significant effect on student test scores compared to TPSs in the pooled OLS and student random effects models. Attending a charter school is associated with, on average, a .04 increase in a student's standardized reading test score compared to a TPS student.

The non-linear time-nested within-student random coefficient growth models provide a more optimistic picture of student achievement in charter schools and start to provide some explanation for the conflicting results discussed above (Table 2.5).[3] Charter school students in 4th grade start behind their TPS peers in both math and reading, as shown by the negative and statistically significant charter school coefficient. However, the interaction effect between charter school and grade shows that charter school students' positive trajectory is significantly larger compared to TPS students; students in charter schools have on average a .07 increase in their

[2]Including grade-year fixed effects models provided similar results to the quadratic time models.

[3]Linear growth models were also run and provided similar results to non-linear models (see Appendix Table A1). However, the non-linear growth models are presented in order to depict a more nuanced picture of the effects of charter schools on student achievement.

math standardized test scores and .04 increase in the growth of their reading standardized test scores compared to TPS students. The effect of charter schools slightly decreases when including the interaction effect between grade squared and charter for the math sample, although not enough to negate the overall positive trajectory of charter school test score growth. The interaction term of grade squared and charter has no effect on reading achievement.

The results from the multilevel growth model are best understood by examining test score growth trajectories graphically (Figure 2.1 and 2.2). For both math and reading, charter school students have a positive growth trajectory, while TPS student growth is relatively constant. In both the math and reading samples, charter school student achievement eventually surpasses TPS student achievement.

Results by Switcher Type

I ran additional multilevel models on subgroups of charter school students (Figure 2.3-2.6). Almost none of the slopes of the charter school subgroups were negative. Not surprisingly, students only observed in charter schools had the largest positive growth trajectory (Figure 2.3). However, the most revealing results came from examining the varying trajectories of each switcher group. In models used to compare, first, TPS only students and students who switched into charter schools, and second, TPS only students and students who switched schools multiple times, the trajectories of the subsets of charter school students initially increased before gradually leveling out (Figures 2.4 and 2.6, respectively). Examining the results of the sample of TPS only students and those who switched out of charter schools, charter schools students experienced a positive growth trajectory while those in TPS experience a negative growth trajectory (Figure 2.5). Compared to the negative growth trajectory of TPS only students, the subgroups of charter

school students have, in general, positive growth trajectories although these trajectories still vary depending on the subgroup.[4]

Discussion

My study makes several contributions to the existing literature on charter schools including explaining how past research on charter school student achievement has drawn such a wide range of conclusions. Additionally, my present findings challenge previous literature in North Carolina that employed student fixed effects models and found that charter schools decreased student achievement. Specifically, I show that these results were based solely on a small, unique subpopulation of charter school students. Compared to charter school only students, switchers were from less advantaged backgrounds. While these results have strong internal validity, switchers did not appear to be representative of charter school students in general. These results potentially suggest a story of causal heterogeneity, which was further confirmed by the results from the student random effect models. The random effects model provided substantially different findings. Attending charter schools did not significantly increase students' math test scores compared to students attending a TPS. Charter schools were associated with an increase in reading standardized tests scores. Random effects models account for the whole student population and provide vastly different results from the student fixed effects models. Combined with the student fixed effects model results, these findings are indicative of causal heterogeneity.

Growth models, my preferred model, show that charter schools are actually associated with a positive trajectory in students' math and reading achievement. Further analysis with these models shows that, in general, the positive trajectories of the subgroups of charter school

[4]These figures specifically refer to the math sample. Similar results are found in the reading sample.

students still substantially vary. For example, charter school only students from more affluent backgrounds had the largest positive trajectories in student achievement. In contrast, student from the poorest backgrounds such as students who switched schools multiple times and those who switched out of charter schools still benefitted from charter schools but to a lesser degree. Students who switched out of charter schools have a much gentler upward slope whereas multiple switchers initially benefit from attending a charter school but eventually regress. These findings suggest that student fixed effects and random effects models are not capturing the true effect of charter schools; instead, causal heterogeneity may be the driving force behind these different estimations. Consequently, causal claims on effect of charter schools on student achievement should be interpreted cautiously; estimations appear to be dependent on the specific population of charter school students on which parameters are being estimated.

This study is not without its limitations. First, my results are based on the student population in North Carolina and therefore limits the generalizability of my findings, especially since the rules and policies regarding charter schools varies from one state to the next. Second, as with any study on charter school student achievement, omitted variable bias is always a potential concern. However, the research design used in this study substantially reduces bias from time-variant and time-invariant covariates. Future work should continue to hypothesize and quantify covariates that may predict students' standardized test scores.

Despite the large number of studies evaluating charter school student achievement, more research is needed to garner the true effects of charter schools. These effects cannot be determined solely with research designs using lotteries to evaluate charter schools since these designs will fall prey to issues associated with causal heterogeneity. Future studies should examine the specific effects that charter schools have on student achievement of the

heterogeneous subgroups in charter schools. Research on these particular groups will help delineate which students in charter schools will benefit most from attending them.

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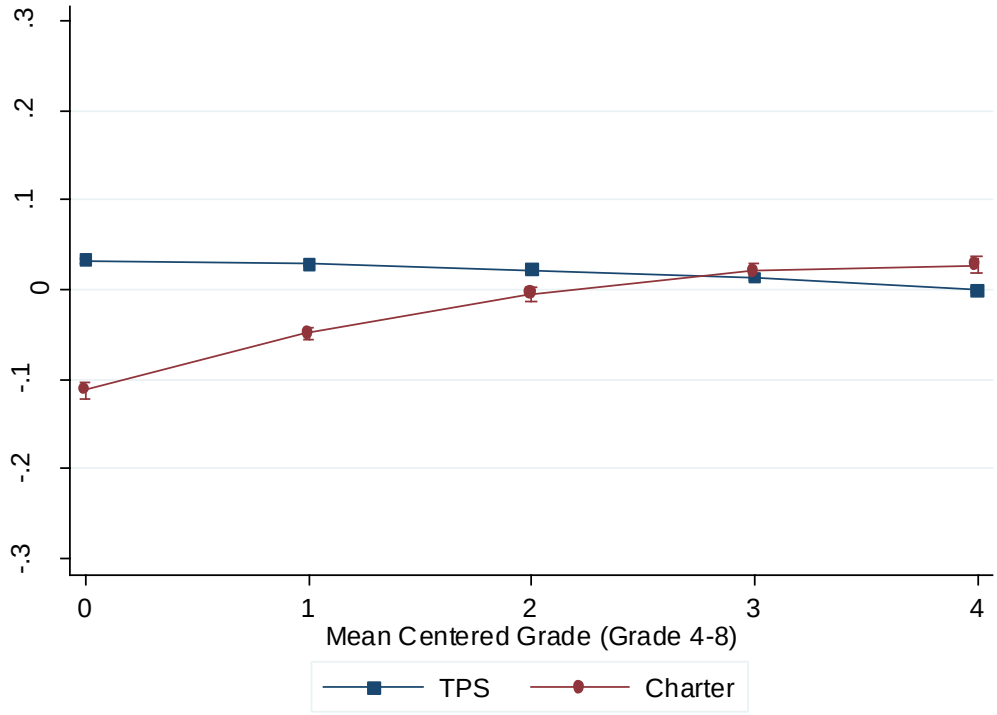

Fig. 2.1 Average Math Test Score Growth, Full Sample

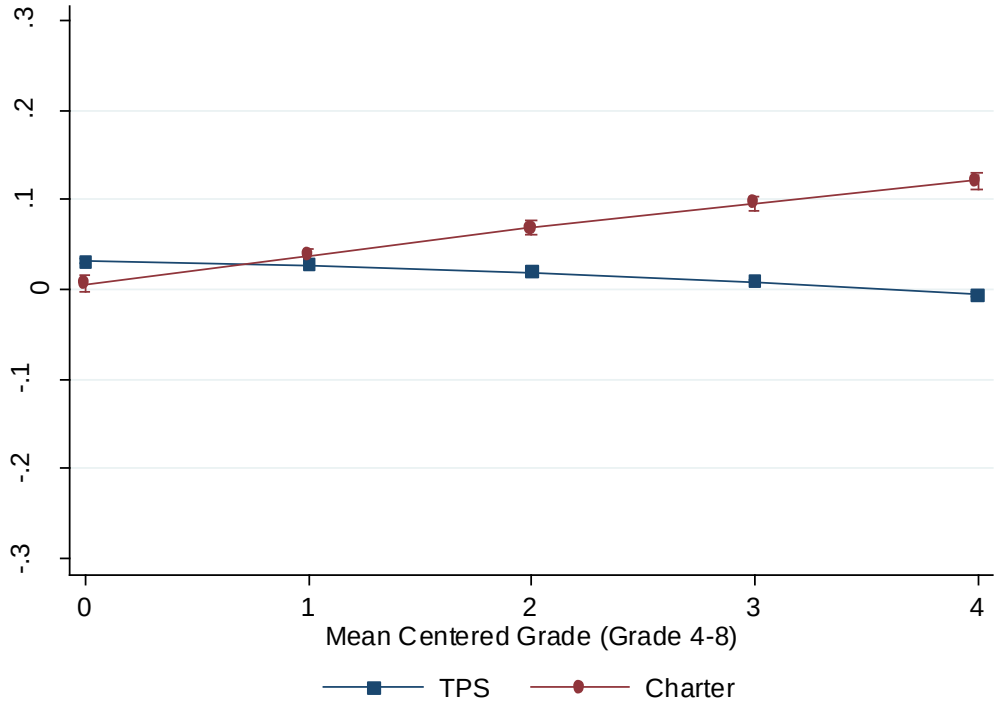

Fig 2.2 Average Reading Test Score Growth, Full Sample

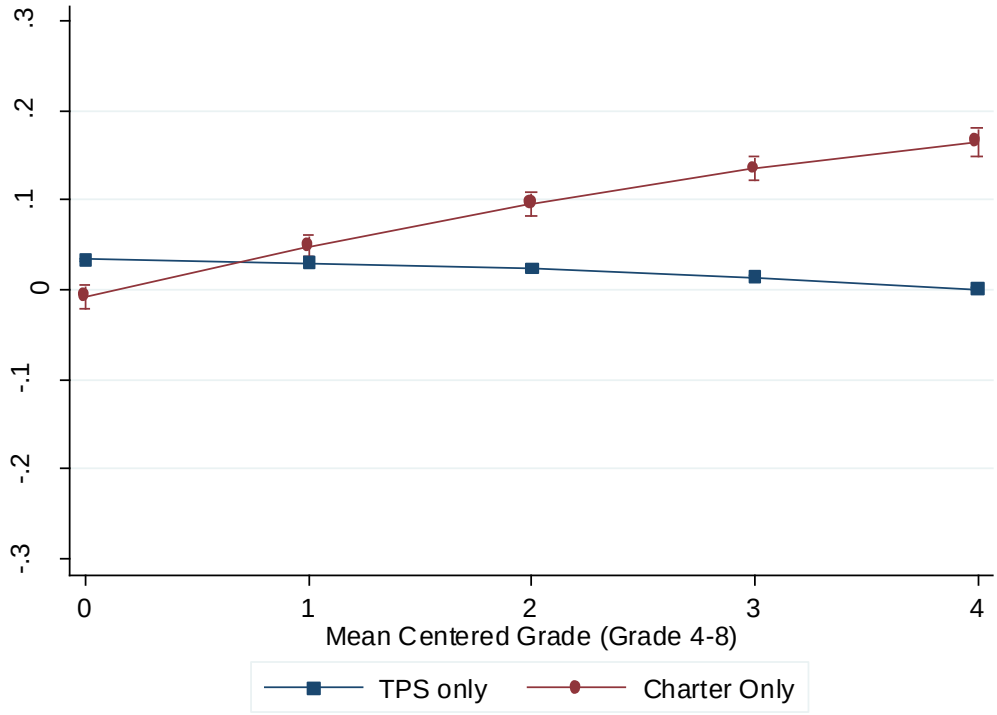

Figure 2.3 Average Math Test Score Growth, TPS only vs Charter only

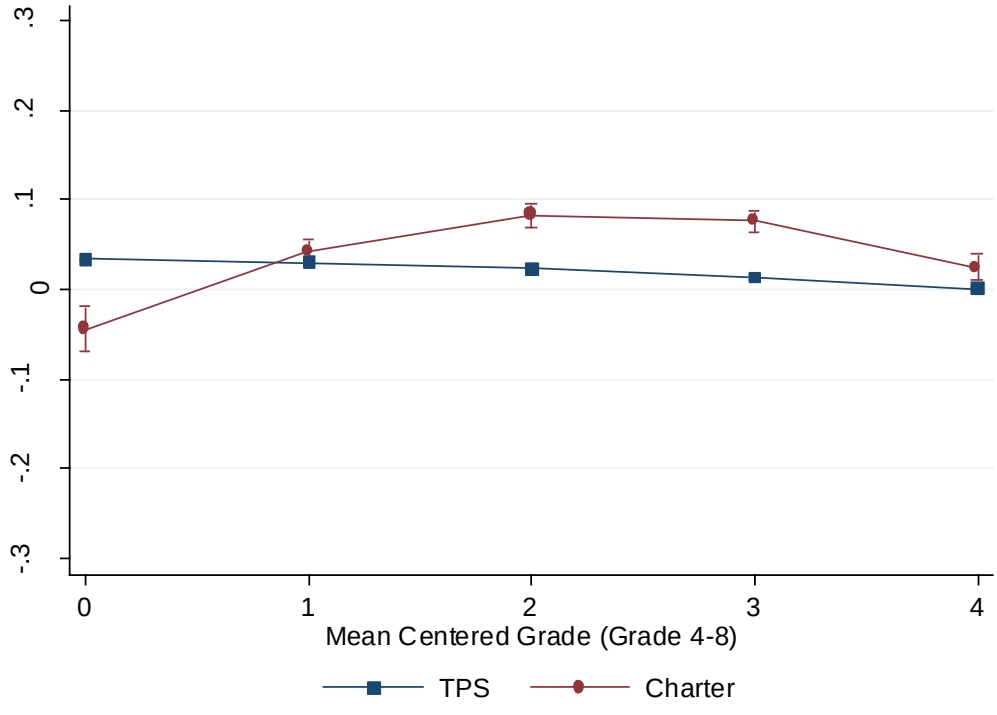

Fig 2.4 Average Math Test Score Growth, TPS only and Switched into Charter

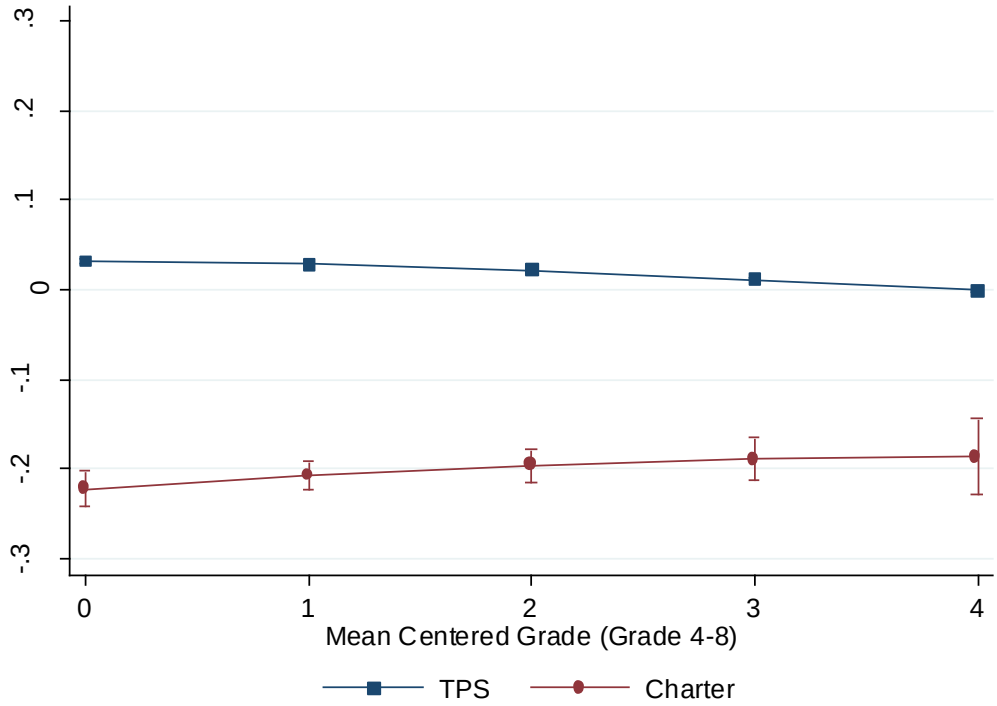

Fig. 2.5 Average Math Test Score Growth, TPS only and Switched out of Charter

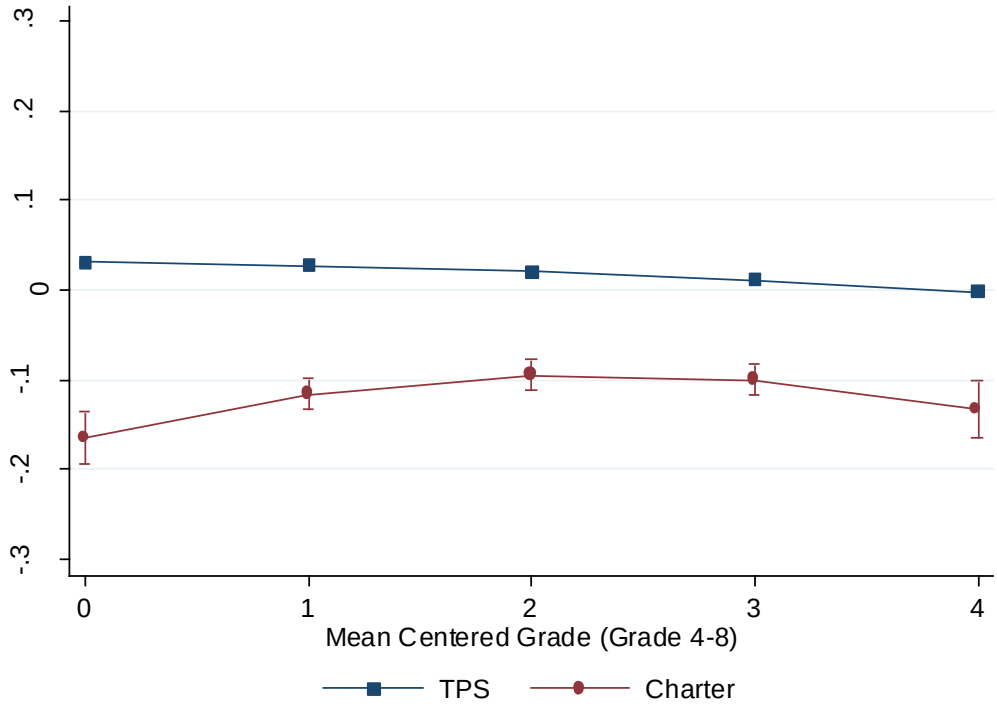

Fig 2.6 Average Math Test Score Growth, TPS only and Multiple Switchers

Table 2.1 North Carolina School Descriptives (2004-2011)

	Traditional Public Schools		Charter Schools	
	%/mean	SD	%/mean	SD
Average Enrollment	545	262	352	270
% Female	48%	0.05	49%	0.05
Title I School	64%	0.48	42%	0.49
Crimes per 100 Students	0.63	1.98	0.26	1.10
Ethnic Composition				
% Black	31%	0.25	37%	0.36
% Latino	10%	0.10	4%	0.06
% White	54%	0.28	54%	0.36
Location				
Urban	25%	0.43	39%	0.49
Suburban	15%	0.36	12%	0.32
Town	12%	0.33	16%	0.36
Rural	48%	0.50	33%	0.47
Observations (school-years)	14514		666	

Note: Averages may be slightly skewed for certain variables since data was missing on a few schools. Less than 1% of data was missing on any one variable reported.

Table 2.2 Descriptive Statistics of North Carolina Students (Grades 4-8, 2004-11)

	Full Sample		Always Observed in TPS		Always Observed in Charter		Switchers	
	%/mean	SD	%/mean	SD	%/mean	SD	%/mean	SD
Math Std. Test Score	0.03	(0.99)	0.03	(0.99)	0.22	(0.96)	-0.10	(1.01)
Math Gain	0.00	(0.56)	0.00	(0.56)	0.03	(0.55)	0.00	(0.59)
Reading Std. Test Score	0.02	(0.99)	0.02	(0.99)	0.27	(0.97)	-0.03	(1.02)
Reading Gain	-0.01	(0.60)	-0.01	(0.60)	0.02	(0.59)	0.00	(0.62)
Free/Reduced Price Lunch	0.47	(0.50)	0.47	(0.50)	0.19	(0.39)	0.37	(0.48)
Retention	0.01	(0.10)	0.01	(0.10)	0.01	(0.09)	0.02	(0.14)
Limited English Proficient	0.05	(0.22)	0.05	(0.22)	0.01	(0.12)	0.01	(0.12)
Disability Status	0.05	(0.22)	0.05	(0.22)	0.05	(0.23)	0.05	(0.23)
Academic Giftedness in Math	0.14	(0.35)	0.14	(0.35)	0.02	(0.15)	0.06	(0.24)
Academic Giftedness in Reading	0.13	(0.34)	0.14	(0.34)	0.03	(0.16)	0.06	(0.25)
Female	0.50	(0.50)	0.50	(0.50)	0.53	(0.50)	0.50	(0.50)
Race								
Asian	0.02	(0.14)	0.02	(0.14)	0.02	(0.13)	0.01	(0.10)
Black	0.27	(0.45)	0.27	(0.44)	0.22	(0.41)	0.37	(0.48)
Hispanic	0.08	(0.27)	0.08	(0.28)	0.03	(0.18)	0.03	(0.17)
American Indian	0.01	(0.12)	0.01	(0.12)	0.01	(0.10)	0.02	(0.14)
Multiracial	0.03	(0.18)	0.03	(0.18)	0.03	(0.16)	0.04	(0.19)
White	0.58	(0.49)	0.58	(0.49)	0.69	(0.46)	0.53	(0.50)
Observations (student-years)	3861493		3712110		49910		99473	

Notes: EOG test scores were standardized with a mean of zero and a standard deviation of 1 by grade and year. Test scores refer to students' baseline test scores in 4th grade (N= 778799) for the math sample and (N=773874) for the reading sample. Student-years refers to the math sample although the means and standard deviations for reading standardized test score, reading gain, and academic giftedness in reading are from the reading sample (N=3843599).

Table 2.3 Descriptive Statistics of Switchers (Grades 4-8, 2004-2011)

	Switch In Charter and Stayed In		Switched Out of Charter and Stayed Out		Switched In and Out of Charter	
	%/mean	SD	%/mean	SD	%/mean	SD
Math Std. Test Score	0.12	(1.00)	-0.28	(0.98)	-0.33	(0.97)
Math Gain	-0.02	(0.57)	0.05	(0.60)	-0.02	(0.61)
Reading Std. Test Score	0.19	(0.96)	-0.19	(1.00)	-0.20	(0.98)
Reading Gain	-0.01	(0.60)	0.03	(0.64)	-0.02	(0.65)
Free/Reduced Price Lunch	0.29	(0.45)	0.40	(0.49)	0.50	(0.50)
Retention	0.01	(0.12)	0.02	(0.15)	0.03	(0.17)
Limited English Proficient	0.02	(0.13)	0.01	(0.12)	0.01	(0.11)
Disability Status	0.05	(0.21)	0.06	(0.24)	0.06	(0.23)
Academic Giftedness in Math	0.08	(0.27)	0.06	(0.24)	0.04	(0.20)
Academic Giftedness in Reading	0.08	(0.27)	0.06	(0.24)	0.04	(0.20)
Female	0.52	(0.50)	0.50	(0.50)	0.48	(0.50)
Race						
Asian	0.01	(0.12)	0.01	(0.10)	0.01	(0.08)
Black	0.29	(0.45)	0.41	(0.49)	0.47	(0.50)
Hispanic	0.03	(0.18)	0.03	(0.16)	0.03	(0.18)
American Indian	0.02	(0.14)	0.01	(0.11)	0.03	(0.17)
Multiracial	0.03	(0.18)	0.04	(0.19)	0.05	(0.21)
White	0.61	(0.49)	0.51	(0.50)	0.41	(0.49)
Observations (student-years)	43695		32288		23490	

Notes: EOG test scores were standardized with a mean of zero and a standard deviation of 1 by grade and year. Test scores refer to students' baseline test scores in 4th grade (N= 778799) for the math sample and (N=773874) for the reading sample. Student-years refers to the math sample although the means and standard deviations for reading standardized test score, reading gain, and academic giftedness in reading are from the reading sample (N=3843599).

Table 2.4 Pooled OLS, Student RE, and Student FE Results for Math and Reading Achievement, 2004-2011

	Math Sample						Reading Sample					
	Pooled OLS		Student Random Effects		Student Fixed Effects		Pooled OLS		Student Random Effects		Student Fixed Effects	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
Charter School	0.00	0.00	0.00	0.00	-0.13	0.00 ***	0.04	0.00 ***	0.04	0.00 ***	-0.05	0.00 ***
Lagged Test Score	0.76	0.00 ***	0.69	0.00 ***	-0.10	0.00 ***	0.73	0.00 ***	0.64	0.00 ***	-0.15	0.00 ***
Structural Change												
Non-Structural Change	-0.06	0.00 ***	-0.06	0.00 ***	-0.02	0.00 ***	-0.04	0.00 ***	-0.04	0.00 ***	-0.01	0.00 ***
Structural Change	-0.05	0.00 ***	-0.05	0.00 ***	-0.02	0.00 ***	-0.04	0.00 ***	-0.04	0.00 ***	-0.01	0.00 ***
No Change (ref.)												
Demographics												
Female	0.02	0.00 ***	0.02	0.00 ***			0.03	0.00 ***	0.04	0.00 ***		
Free/Reduced Price Lunch	-0.10	0.00 ***	-0.12	0.00 ***	0.00	0.00 *	-0.12	0.00 ***	-0.14	0.00 ***	0.00	0.00
Retention	0.29	0.00 ***	0.29	0.00 ***	0.02	0.00 ***	0.29	0.00 ***	0.29	0.00 ***	-0.07	0.00 ***
Limited English Proficient	-0.06	0.00 ***	-0.09	0.00 ***	-0.02	0.01 ***	-0.14	0.00 ***	-0.20	0.00 ***	-0.03	0.01 ***
Disability Status	-0.13	0.00 ***	-0.16	0.00 ***	0.04	0.00 ***	-0.16	0.00 ***	-0.21	0.00 ***	0.00	0.00
Academic Giftedness	0.24	0.00 ***	0.29	0.00 ***	0.00	0.00 *	0.25	0.00 ***	0.30	0.00 ***	-0.02	0.00 ***
Race												
Asian	0.15	0.00 ***	0.18	0.00 ***			0.08	0.00 ***	0.10	0.00 ***		
Black	-0.10	0.00 ***	-0.15	0.00 ***			-0.13	0.00 ***	-0.18	0.00 ***		
Hispanic	0.02	0.00 ***	0.01	0.00 ***			0.01	0.00 ***	-0.01	0.00 ***		
American Indian	-0.09	0.00 ***	-0.12	0.00 ***			-0.12	0.00 ***	-0.16	0.00 ***		
Multiracial	-0.03	0.00 ***	-0.04	0.00 ***			-0.02	0.00 ***	-0.04	0.00 ***		
White (ref.)												
Observations (student-years)	3829212		3829212		3829212		3811437		3811437		3811437	

Note: All models include time fixed effects.

*Statistically significant at the 5% level **Statistically significant at the 1% level ***Statistically significant at the .1% level

Table 2.5 Non-Linear Multilevel Growth Models, 2004-2011

	Math Standardized Test Score		Reading Standardized Test Score	
	Coef.	SE	Coef.	SE
Charter School	-0.14	(0.00) ***	-0.03	(0.00) ***
Grade	-0.01	(0.00) ***	-0.02	(0.00) ***
Charter School X Grade	0.07	(0.00) ***	0.04	(0.00) ***
Grade X Grade	0.00	(0.00) *	0.00	(0.00) ***
Charter School X Grade X Grade	-0.01	(0.00) ***	0.00	(0.00)
Structural Change				
Non-Structural Change	-0.05	(0.00) ***	-0.03	(0.00) ***
Structural Change	-0.08	(0.00) ***	-0.05	(0.00) ***
No Change (ref.)				
Demographics				
Female	-0.03	(0.00) ***	0.13	(0.00) ***
Free/Reduced Price Lunch	-0.17	(0.00) ***	-0.19	(0.00) ***
Retention	0.25	(0.01) ***	0.18	(0.01) ***
Limited English Proficient	-0.40	(0.00) ***	-0.54	(0.00) ***
Disability Status	-0.27	(0.00) ***	-0.45	(0.00) ***
Academic Giftedness	0.55	(0.00) ***	0.52	(0.00) ***
Race				
Asian	0.32	(0.01) ***	0.10	(0.01) ***
Black	-0.66	(0.00) ***	-0.60	(0.00) ***
Hispanic	-0.20	(0.00) ***	-0.28	(0.00) ***
American Indian	-0.53	(0.01) ***	-0.53	(0.01) ***
Multiracial	-0.24	(0.00) ***	-0.21	(0.00) ***
White (ref.)				
Observations (student-years)	3861493		3843599	

Note: Grade recentered at 0. Models include interactions between student demographic controls and grade and grade squared. Robust SEs in parentheses.

*Statistically significant at the 5% level **Statistically significant at the 1% level

***Statistically significant at the .1% level

CHAPTER 3: THE EFFECT OF CHARTER SCHOOLS ON BEHAVIORAL OUTCOMES: EVIDENCE FROM NORTH CAROLINA

Introduction

Since 1991, 42 states and the District of Columbia have adopted charter school legislation. Charter schools serve more than 2.5 million children (National Alliance for Public Charter Schools, 2015) in approximately 6,100 schools across the U.S. (NCES, 2015), and these rates increase annually. Additionally, charter schools continue to garner support from both parents and students (Barrett, 2003; Buckley & Schneider, 2009; Gleason et al., 2010; McCully & Malin, 2003). In a multi-state study, parents of charter school students were 33% more likely to rate their school as excellent compared to parents of traditional public school (TPS) students. However, charter schools' high ratings were not necessarily due to increases in student achievement. Rather, parents cited the stricter and more disciplined environments of charter schools as one of the primary reasons that they were satisfied with their child's charter school (Gleason et al., 2010).

While there is a substantial amount of research exploring the effects of charter schools on student achievement, few studies have examined the effects of charter schools on students' behavioral outcomes despite their importance in determining students' future success. For example, self-discipline has been shown to predict students' grades, standardized test scores, and hours spent on homework (Duckworth & Seligman, 2005, 2006). Additionally, wages, work experience, and other life outcomes have been directly related to students' behavioral outcomes (Heckman, Stixrud, & Urzua, 2006; Heckman & Rubinstein, 2001). Indeed previous research has

even suggested that behavioral skills better explain differences in wages than cognitive skills (Bowles & Ginits, 1976; Bowles, Gintis, & Osborne, 2001; Carneiro, Heckman, & Masterov, 2005). These results suggest that the development of adolescents' behavioral skills are just as essential, if not more so, than the development of their cognitive skills.

Using data from North Carolina, this study examines whether charter schools influence students' behavioral outcomes. Few studies have looked at students' behavioral and non-cognitive development (Dobbie & Fryer, 2013; Imberman, 2011). This study contributes to the existing literature on charter schools by examining a largely overlooked dimension of student outcomes on which to evaluate the success of charter schools. Benefits of charter schools on students' behavioral outcomes may explain the positive externalities (i.e. non-cognitive skills) associated with charter schools as well as why more charter school students are graduating from high school and attending college (Angrist et al., 2013).

Theoretical Considerations

As one of the many forms of school choice, charter schools developed as a way to decentralize public education. Both charter and TPSs receive public funding. However, charter schools can receive financial support from donors or other charitable organizations. Additionally, charter school students do not have to reside in a certain district or neighborhood to be eligible to attend and are not subject to the same rules and regulations as TPSs (Henig, 2005). In North Carolina, a charter school's board of directors is in charge of the budget, curriculum, and other operational activities. For example, the school board is not required to provide transportation or meals to students, even students who qualify for free and reduced lunch programs.

Market theory and institutional theory help explain how and why charter schools may affect student outcomes, including students' behavioral outcomes. Market theory posits that, in general,

competition and choice drive producers to offer higher quality products. Applying this logic to the U.S. education system, market theorists propose that allowing students to choose the school they want to attend and making schools compete for students leads to better, higher quality education (Betts & Loveless, 2005; Bulkley & Wohlstetter, 2004; Chubb & Moe, 1990). In contrast, highly regulated and systematized TPSs have little incentive to improve or maintain a certain standard of quality (Chubb & Moe, 1990). Allowing charter schools to be deregulated and decentralized provides them with the autonomy to improve student outcomes. Specifically, charter schools are able to rapidly respond to the needs and preferences of their community by adopting innovative practices (Bulkley & Wohlstetter, 2004; Vieteritti, 1999).

Milton Friedman and Gary Becker both claimed that choice and competition "would induce a fast rate of innovation" in schools (Becker, 1999, p. 2; Friedman, 1955; Chubb & Moe, 1990; Coulson, 1999; Friedman & Friedman, 1980; Gintis, 1995; Lubienski, 2005). Charter schools compete for students and consequently, stay focused on the needs of the consumers (i.e. students and families), facilitating a rapid rate of innovation in teaching and education. These instructional, curricular, and adminstrative changes are directed at improving students' well-being (Lubienski, 2005).

Students' well-being and ultimate success undoubtedly includes behavioral outcomes. Indeed, in Lubienski's (2003) literature review of innovative standards adopted by charter schools, many new practices are related to organizational activities and not necessarily directly related to student achievement in the classroom. For example, several charter schools focus on instilling shared community values, such as the value of receiving an education (Strike, 2010).

In contrast to market theory, institutional theory suggests that charter schools will not be markedly different from TPSs. Institutional theory assumes that organizations, such as schools,

are highly regulated and static (DiMaggio & Powell, 1983) due to the overwhelming influence of an organization's history (North, 1990). Consequently, communities with strong values define what is considered to be a legitimate school. To be successful, new schools are strongly incentivized to adopt similar norms and structures that validate and legitimize existing customs. Ultimately, this leads to organizational isomorphism (Meyer & Ramirez, 2000; Meyer & Rowan, 1977), and suggests that charter schools ultimately revert back to more traditional learning systems without innovative practices (Lubienski, 2005).

These theories provide conflicting hypotheses. According to market theory, innovative practices adopted by charter schools should ultimately lead to improving their students' behavioral outcomes. In contrast, institutional theory posits that charter schools would actually adopt similar practices and norms of TPSs, and thus, charter school students' behavioral outcomes would be unchanged.

Background

Behavioral outcomes

Research focusing on children's behavior illustrates its importance on both short- and long-term student outcomes (Heckman et al., 2006; Heckman & Rubinstein, 2001). Heckman and his colleagues (2006) found that adolescent behavior and non-cognitive abilities influence their future degree attainment and wages. In studies comparing the wages of GED-holders to high school dropouts, results showed that dropouts actually earned higher wages than GED-holders after controlling for behaviorial outcomes. This wage differential, in fact, was due to the differences in these groups' behavioral (Cameron & Heckman, 1993; Heckman, Hsse, & Rubinstein, 2000). Similarly, after analyzing the results from 24 studies, Bowles and Gintis (2002) determined that the effect of cognitive skills on future earnings is, on average, reduced by

18 percent when behaviorial measures are included in their analysis. Improvement in students' behavioral outcomes leads to increases both students' productivity and earnings by instilling students with the correct habits and skills to succeed in the workforce.

Many studies suggest that behavioral outcomes are reflective of non-cognitive skills. (Heckman et al., 2006) Consequently, previous studies have used attendance records and suspensions as proxies for measuring non-cognitive skills (Imberman, 2011; Jackson, 2012; Segal, 2013). In North Carolina, Jackson (2012) used absences, suspensions, grades, and on-time grade progression to measure students' non-cognitive skill level, and showed that these measures were predictive of students' future arrests, employment, and earnings.

Charter School Outcomes

Previous research on charter schools has been particularly focused on examining students' cognitive skills, including test scores, educational attainment, and college enrollment. The effects of charter schools on standardized test scores have provided conflicting results. Some charter schools have little to no positive effect on their students' test scores (Abdulkadiroglu et al., 2011; Angrist et al, 2010; Booker et al., 2007; Hoxby & Murarka, 2009; Hoxby & Rockoff, 2004; Sass, 2006; Witte, et al., 2007; Zimmer, et al., 2009). In some cases, studies have even found that charter schools lowered student achievement compared to TPS students (Bettinger, 2005; Bifulco & Ladd, 2006; Carruthers, 2012; Zimmer & Buddin, 2006). National studies comparing student achievement between charter school and TPS students determined that, after controlling for student demographics, charter school student achievement was, in general, no different from TPS student achievement (CREDO, 2013; Lubienski & Lubienski, 2006). Most recently, a study evaluating data from 26 states determined that while some charter schools are

improving test scores, about 19 percent and 31 percent still perform worse than TPSs in reading and math, respectively (CREDO, 2013).

While charter schools may not uniformly improve student test scores, studies evaluating other indicators of academic success such as educational attainment have provided more positive results (Booker et al., 2009; Booker et al., 2011; Furgeson et al., 2012; Angrist et al., 2013; McClure et al., 2005). In San Diego, charter school lottery winners were more likely to report plans to attend a 4-year college compared to lottery losers (McClure et al., 2005). Even after controlling for demographic characteristics, charter school students are more likely to graduate from high school and to attend college than their TPS peers (Booker et al., 2009). On average, attending a charter high school increased students' likelihood of attending college by 8 to 10 percentage points while attending both a charter middle and high school increased students' chances of going to college by 7 to 15 percentage points (Booker et al., 2011). In a study examining charter management organizations, charter students were 21 to 23 percent more likely to enroll in college (Furgeson et al., 2012). While some studies have found no significant effects of charter schools on educational attainment, they have found positive effects on charter students' transition from a 2-year to 4-year college and on their SAT scores (Angrist et al., 2013). In general, students attending charter schools have higher educational attainment than those in TPSs.

A few studies have examined the effects of charter schools on behavioral outcomes (Dobbie & Fryer, 2013; Imberman 2011). One study found that, in general, students' attendance and discipline improved after transferring from a TPS to a charter school at all grade levels. Specifically, Imberman (2011) found that while charter schools did not increase students' test scores, but they did improve students' absences. Studies of the Harlem Children's Zone show

that female and male students attending the Promise Academy (a charter school) were, respectively, 12.1 percentage points less likely to become pregnant and 4.3 percentage points less likely to be incarcerated (Dobbie & Fryer, 2013). While there is limited research on charter students' behavioral outcomes, the few studies conducted have shown positive results. I contribute to this growing literature by looking specifically at schools in North Carolina, where most studies on charter school student achievement have found negative effects. Additionally, to date, I use the most comprehensive list of behavioral outcomes.

Data

Data and Sample

The North Carolina Department of Public Instruction (NCDPI) collects administrative data on all public and charter school students in the state. These data are maintained by the North Carolina Education Research Data Center and include information on students, teachers, classrooms, schools, and districts in North Carolina. Students are longitudinally linked and therefore can be followed over time.

My sample includes all TPS and charter school students in grades 3 through 8 from 2006 to 2009. Approximately 2.6 million observations of 1.1 million students were included in my analytic sample. While data has been collected on student attendance and suspension rates up to 2011, there was a high amount of missing data during the latter years, and thus, these data were excluded from my analysis.[5] Additionally, listwise deletion was employed on observations missing data on dependent or independent variables (Carruthers, 2012).

[5]Models were run with a larger sample using data up to 2011. Overall, my conclusions remained the same.

Measures

Dependent Variables

Absences. Measures of behavioral outcomes included absences, tardies, and suspensions. Absences are measured using two separate indicators: 1) number of days absent and 2) number of days of unexcused absences. Parents or guardians are required to notify schools if their child is going to be absent and to provide a reason for the absence. Students receive excused absences for any of the following reasons: 1) illness or injury; 2) quarantine, 3) death in the immediate family, 4) medical or dental appointments, 5) court or administrative proceedings, 6) religious observance, 7) educational opportunity, 8) local school board policy, 9) absence related to deployment activities, and 10) child care. Any other reason for being absent is considered unexcused (NCDPI, 2014).

Tardies. Tardiness is measured by the number of days a student is late to school. Students may be suspended for up to 2 days for "excessive tardiness" (NCDPI, 2014).

Suspensions. Students may incur out-of-school and in-school suspensions. Each type of suspension is measured in two ways: 1) number of times a student was suspended and 2) number of days a student was suspended. Students may be suspended for violating the local education board's Code of Student Conduct. In-school suspensions include assignments to alternative school programs for a short period of time (NCDPI, 2015).

Independent Variables

Charter School. Students were identified as attending a charter school or a TPS. This is the main independent variable of interest.

Years in Charter School. The number of consecutive years a student attended a charter school was grouped into four categories: first year in a charter school, second year in a charter school, third year in a charter school, and fourth year or more in a charter school.

Additional Controls. Time-invariant covariates included race and gender. Race was comprised of five categories including black, Asian, Hispanic, Native American, multiracial, and white. White was the referent category.

Time-variant covariates included dummy variables indicating limited English proficient status (LEP), disability status, free or reduced price lunch eligibility, academic giftedness, and Title 1 school. Indicators of structural change and non-structural change, with no change being the reference category, were also included. A structural move is defined as a situation in which a student and at least 30 percent of those in his or her same grade and school moved together to another school (Carruthers, 2012; Sass, 2006). In other words, a structural move is made if a student moves from elementary school to middle school. A non-structural move indicates if a student changed schools during elementary or middle school. Students were considered academically gifted if they identified as gifted in either math or reading or both. Students were labeled as disabled if they had a learning disability in one or more of four areas: reading, writing, math, or other. Lastly, models included grade and grade squared.

Methods

To estimate the effect of charter schools on behavioral outcomes, I estimate pooled ordinary least squares (OLS), student random effects, and student fixed effects models. The student random effects and fixed effects models build on the pooled OLS model. Each of these models has certain strengths and weaknesses, which are discussed in more detail below.

Pooled OLS

I begin my analysis by estimating a pooled OLS model of the education production function. This model includes:

$$(1)\ Y_{ti} = \beta_0 + \beta_1 Charter_{ti} + \beta_2 Grade_{ti} + \beta_3 Grade^2_{ti} + \beta_4 \mathbf{XT}_{ti} + \beta_5 \mathbf{X}_i + \varepsilon_{ti}$$

where Y is the one of the behavioral dependent measures at time *t* for student *i* and is regressed on a charter indicator, grade, and grade squared. Vectors of time-variant covariates (**XT**) and time-invariant covariates (**X**) were also included.

There are two major assumptions that, if violated, would lead to biased estimates of the pooled OLS model. First, this model assumes that the error term, ε_{ti}, is independent across observations. Since my data is longitudinal, this assumption does not hold. Second, estimates from pooled OLS models are unbiased only if all possible confounding factors are included in the model. Previous literature was used to determine which confounding covariates were to be included in the present model. However, in any model, this assumption is typically violated since it is difficult to identify and measure all confounding covariates.

Student Random Effects Model

To account for the longitudinal nature of the data analyzed, I use a student random effects model. This model is more efficient and less biased than the pooled OLS model. Random effects models use precision-weighted least-squares estimates calculated from between effects and fixed effects models. In other words, random effects models provide the weighted average of the between and fixed effect estimates. Specifically, I estimate the following model:

$$(2)\ Y_{ti} = \beta_0 + \beta_1 Charter_{ti} + \beta_2 Grade_{ti} + \beta_3 Grade^2_{ti} + \beta_4 \mathbf{XT}_{ti} + \beta_5 \mathbf{X}_i + \varepsilon_{ti} + u_{0i}.$$

The key difference between the pooled OLS and random effects model is the random effects model allows for within-unit correlations. In other words, an individual student's error term (u_{0i}) is clustered across time while ε_{ti} still accounts for the student's time-varying residual. Similar to the pooled OLS model, both time-invariant and time-variant covariates are included to ensure the least biased estimates.[6]

Student Fixed Effects Model

The final model analyzed was the student fixed effects model. This model includes:

$$(3)\ Y_{ti} = \beta_0 + \beta_1 Charter_{ti} + \beta_2 Grade_{ti} + \beta_3 Grade^2_{ti} + \beta_4 \mathbf{XT}_{ti} + \lambda_i + \varepsilon_{ti}$$

where each student is allowed his or her own deviation, λ_i , from the mean intercept (β_0). The main advantage of using a student fixed effects model is that students are only being compared to themselves, and thus, time-invariant observable and unobservable covariates are not included as possible confounders. However, student fixed effects model estimates are based solely on switchers, i.e. students who switch from charter schools to TPSs or vice versa. Consequently, these estimates may not apply to students who are only observed in charter schools. To determine the validity of this model, researchers must determine if switchers are representative of the entire charter school population. Unlike equations (1) and (2), equation (3) only includes time-varying covariates ($\mathbf{XT}_{ti}$) as possible confounders.

[6]Linear and non-linear growth models, variations of student random effects models were also analyzed. These are a type of random effects model, and provided similar results to the student random effects model used.

Other Models

Other models considered included a hurdle regression model. This model is similar to a 2-part model and is used when there is zero-inflation of the dependent variable. The first part of the model includes a logit or probit binary model with a dummy variable indicating whether the actual count is greater than zero. The second part of the model includes a zero-truncated count model, such as a Poisson or negative binomial model that is run on non-zero counts only. The hurdle model was not used for two reasons. First, these models have limited interpretation when fixed effects are included. Second, because nonrandom assignment is an overwhelming concern when estimating charter school effects, these models would provide biased estimates without taking into account the longitudinal nature of the data.

Sensitivity Analyses

To determine the robustness of the models used in this study, two alternative specifications were also examined. First, VAMs were estimated. VAMs assume that prior inputs can be summarized by a student's lagged outcome variable (Todd & Wolpin, 2003; Todd & Wolpin, 2007). However, this model also induces endogeneity since prior inputs most likely influence current inputs. Second, there may be effects that are grade and year specific. To test this issue, I also examined models in which grade and grade squared were replaced with grade-year indicators. Results from both of these model specifications were similar to those presented below.

Results

My analysis begins by examining the descriptive characteristics of TPSs and charter schools in North Carolina (Table 3.1). This provides initial evidence that charter schools have different environments compared to TPSs. In North Carolina, charter schools have less crime per

100 students (.17 vs. .61), lower school enrollment rates (252 vs. 547), and are less likely to be Title I schools (19% vs. 58%). Charter schools have slightly higher proportions of black students than TPSs (37% vs. 31%) but similar percentages of white students (53% vs. 54%). Overall, charter schools may produce better learning environments compared to TPSs.

Examining the differences in the characteristics of charter school only students, TPS only students and switchers illustrated that, overall, switchers appear to be negatively selected compared to charter school only students (Table 3.2). Switchers are more likely to be absent, tardy, and suspended than charter school only students. Additionally, switchers are more likely to be eligible for free or reduced price lunch (36% vs. 18%), to attend a Title I school[7] (25% vs. 8%) and to be black (37% vs. 23%) than charter school only students. The majority of charter school only students are white (68%). Similar shares of disabled (5%) and LEP students (2%) were switchers and charter school only students. Due to switchers being negatively selected, the results from the student fixed effects model will most likely underestimate the effect of charter schools on students' behavioral outcomes.

Among absences, unexcused absences, and tardies, the effect of charter schools varied (Table 3.3). For the outcome, days absent, charter schools are associated with a statistically significant decrease in the number of days absent in all model specifications. Using the student fixed effects model, a charter school student misses .28 days less than a TPS student. Therefore, attending a charter school is associated with a modest decrease in the average number of days a student is absent. The effect of charter schools on the number of unexcused absences varies depending on the model specification; the pooled OLS and student random effects models show that charter school students have fewer unexcused absences compared to TPS students. However,

[7]Similar to TPSs, public charter schools can receive Title I funds and are still held accountable for making adequate yearly progress.

using the student fixed effects model, charter school students have .17 more days of unexcused absences compared to TPS students. In other words, switchers, or students with worse background characteristics, have fewer unexcused absences. Finally, charter schools have no statistically significant effect on the number of days a student is tardy.

In all model specifications, charter school students had fewer and shorter in-school and out-of-school suspensions compared to TPS students (Table 3.4). Both the student random and fixed effects models on the days of in-school suspensions show that charter school students have shorter in-school suspensions, equating to about half a day, compared to TPS students. Using student random effects, charter school students' out-of-school suspensions are a little more than half a day (.62) shorter compared to TPS's out-of-school suspensions. The student fixed effects model shows that charter school students out-of-school suspensions are about one day (.92) shorter compared to those in TPSs.

To explain the variation in the coefficients among the student fixed effects models using absences, unexcused absences, and tardies as outcomes, the effect of a student's time in a charter school was examined (Figure 3.1). For all dependent variables, the beneficial effect of charter schools on student's behavioral outcomes increased the longer a student attended a charter school; in other words, as students continued to attend charter schools, they had fewer absences and in-school and out-of-school suspensions. Charter schools had no statistically significant effect on students' tardiness during their first year of attending a charter school. By their second year, however, charter school students received fewer tardies compared to TPS students. In fact, the longer a student remained in a charter school, the fewer tardies a student received each year. The effect of attending a charter school on unexcused absences followed a similar trend but did

not become significantly different from TPSs until students had attended a charter school for at least 4 years.

Discussion

Charter schools in North Carolina appear to provide better learning environments for students compared to TPSs. Consequently, even when negatively selected students switch into charter schools, their behavioral outcomes improve as measured by behavioral outcomes such as absences, tardies, and suspensions. Suspensions and regular absences decrease immediately. In terms of tardiness and unexcused absences, students must be enrolled in a charter school for at least 2 years before students' tardiness decreases and about 4 years before students' unexcused absences decrease. The effects of charter schools on students' behavioral outcomes may develop in an even shorter time frame, considering these estimates are based on negatively selected switchers.

The student fixed effects model most likely underestimates the effect of charter schools on students' behavioral outcomes, considering that switchers appear to be negatively selected compared to charter school only students. One might suggest that charter schools should have the biggest impact on negatively selected students. Most likely, the true marginal effect of charter schools on behavioral outcomes falls between the coefficients computed by the student random effects and student fixed effects models. Consequently, it could be argued that charter schools indeed decrease students' absences and all types of suspensions.

Some studies have found that the impact of charter schools on student absences does not necessarily develop due to the positive environment of charter schools, but instead, due to students' ability to choose the school they wish to attend. One study found that absences decreased up to 21% for males entering high school after winning a charter school lottery but

prior to actually enrolling in their new charter school (Hastings, Neilson, & Zimmerman, 2012). The results of this present study show that this is not the case in North Carolina since absences continue to decrease the longer a student remains in a charter school. If choice was the only variable affecting students' absences, they would remain constant over time after experiencing one significant drop. Instead, the marginal effect of attending a charter school on student absences increases over time.

These findings have policy implications for charter schools and provide some clarity as to why charter schools are becoming increasingly popular with parents and students. Despite the mixed results charter schools have on student achievement, charter schools appear to have positive effects on several other student outcomes including their behavioral outcomes. Considering the importance of these outcomes in terms of students' future success (Heckman, Pinto, & Savelyev, 2013; Goldin & Katz, 2007; Card, 1999), the growing support for and investment in charter schools is warranted.

While the results of this study were robust to several model specifications, some limitations should be noted. As with all charter school studies that use observational data, selection bias is always a concern. However, by showing that behavioral outcomes continue to improve even among worse-off students provides strong evidence that charter schools are having positive effects on students in general. The by-year results should still be cautiously interpreted since it could be the case that students whose behavioral outcomes are improving are the ones that are deciding to stay in charter schools while those that show no improvement select out of charter schools after one or two years. Second, results using number or days of in-school and out-of-school suspensions should be interpreted cautiously. State policies in North Carolina regarding suspensions are relatively open. Local school boards make their own policies as to

what behaviors and actions lead to suspensions, and thus these results may reflect enforcement differences. Interestingly, most studies have actually shown that charter schools have stricter rules and student conduct codes than TPSs (Gleason et al., 2010), which suggests that students should be suspended more often if there was no change in their behavioral outcomes. However, these results show that the opposite is true; despite charter schools having stricter student policies, suspensions and tardies decrease.

There are several ways in which research on student behavioral outcomes can be extended. First, this study uses data collected over a 4-year time span up to the year 2009. Future research should use data collected over a longer time period since fixed effects and random effects models work best with several years of data. Second, future research should examine other indicators of behavioral outcomes to test the robustness of my results. For example, other studies have used Likert scales to measure students' competence and classroom adjustment. Additional studies have used the number of times a student gets into a fight or is sent to the office for poor behavior as indicators of behavioral development. As aforementioned, a study on the Promise Academy in the Harlem Children's Zone recently showed that female students were less likely to become pregnant and male students were less likely to be incarcerated (Dobbie & Fryer, 2013).

Finally, as former charter school students start to graduate from college, more studies should determine if charter school students' success as an adult is markedly different from their TPS peers. Studies examining college graduation rates, wages, and employment of charter school graduates would help illustrate whether charter schools are having lasting, positive effects.

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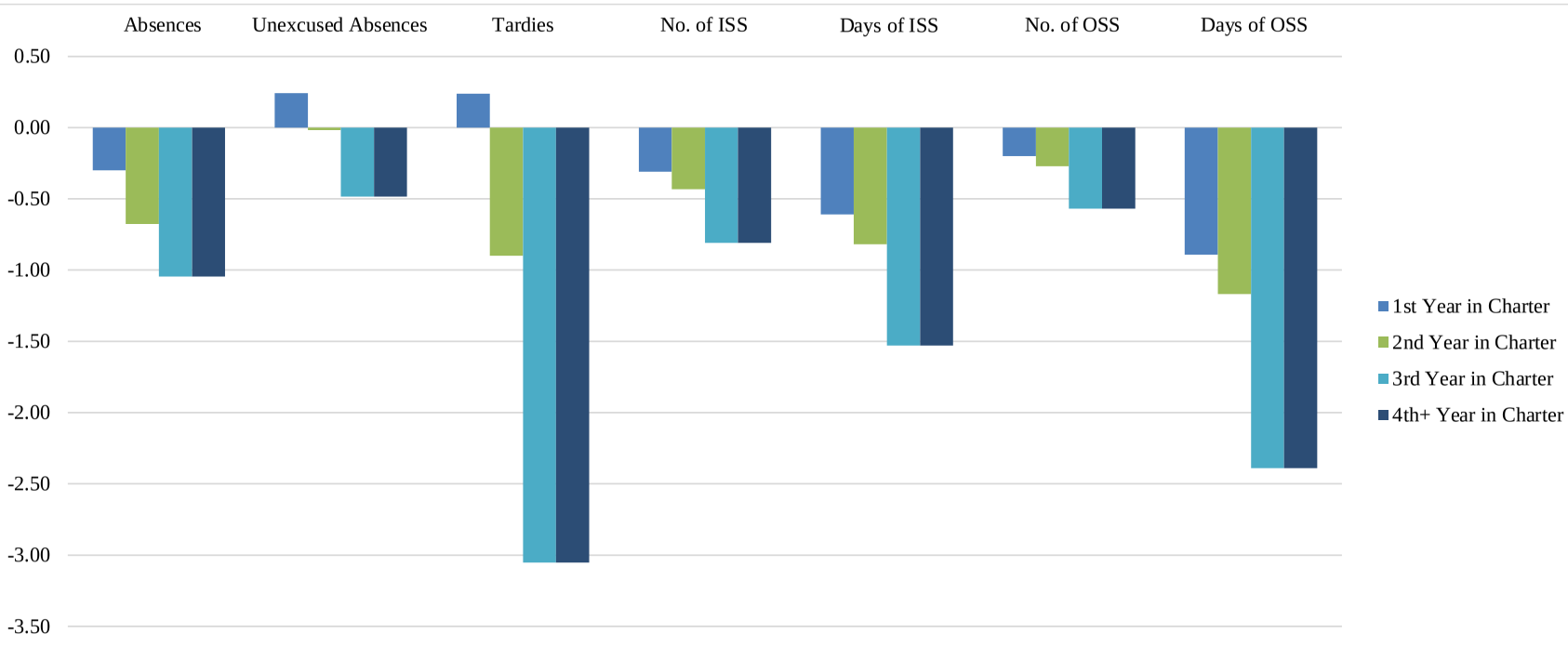

Figure 3.1 Charter Schools Coefficients by Number of Years Student Enrolled in Charter School (Grade 3-12, 2006-2009)

Table 3.1 Descriptive Characteristics of Schools in North Carolina (Grades 3-12, 2006-2009)

	Traditional Public Schools		Charter Schools	
	%/mean	SD	%/mean	SD
Average Enrollment	547	265	252	32
% Female	0.47	0.05	0.49	0.05
Title 1 School	0.58	0.49	0.19	0.39
Crimes per 100 Students	0.61	1.95	0.17	0.53
Ethnic Composition				
% Black	0.31	0.25	0.37	0.36
% Hispanic	0.10	0.10	0.03	0.06
% White	0.53	0.28	0.54	0.37
Location				
Urban	0.24	0.43	0.40	0.49
Suburban	0.15	0.36	0.11	0.31
Town	0.13	0.34	0.15	0.36
Rural	0.47	0.50	0.34	0.47
Observations (school-years)	7309		325	

Note: Averages may be slightly skewed for certain variables since data was missing on a few schools. Less than 1% of data was missing on any one variable reported.

Table 3.2 North Carolina Students (Grades 3-12, 2006-2009)

	TPS Students Only		Charter School Students Only		Switchers	
	%/mean	SD	%/mean	SD	%/mean	SD
Dependent Variables						
Days Absent	7.07	(7.39)	6.18	(6.07)	7.17	(7.29)
Days Unexcused Absent	3.17	(4.80)	2.60	(4.28)	3.23	(4.90)
Number of Tardies	2.02	(5.77)	1.63	(6.23)	2.54	(7.19)
Number of In-School Suspensions	0.25	(1.06)	0.01	(0.12)	0.16	(0.88)
Days In-School Suspension	0.44	(2.17)	0.01	(0.22)	0.28	(1.73)
Number of Out-of-School Suspensions	0.28	(1.04)	0.07	(0.36)	0.27	(1.01)
Days Out-of-School Suspension	0.87	(4.60)	0.17	(2.17)	0.86	(5.03)
Independent Variables						
Free/Reduced Price Lunch	0.47	(0.50)	0.18	(0.38)	0.36	(0.48)
Limited English Proficient	0.06	(0.24)	0.02	(0.13)	0.02	(0.13)
Title I School	0.35	(0.48)	0.08	(0.28)	0.25	(0.44)
Disability Status	0.05	(0.22)	0.05	(0.22)	0.05	(0.22)
Academically Gifted	0.14	(0.34)	0.02	(0.14)	0.07	(0.26)
Female	0.49	(0.50)	0.53	(0.50)	0.50	(0.50)
Race						
Asian	0.02	(0.15)	0.02	(0.13)	0.01	(0.11)
Black	0.27	(0.44)	0.23	(0.42)	0.37	(0.48)
Hispanic	0.10	(0.29)	0.04	(0.19)	0.03	(0.18)
American Indian	0.01	(0.12)	0.01	(0.10)	0.02	(0.14)
Multiracial	0.04	(0.19)	0.03	(0.16)	0.04	(0.19)
White	0.56	(0.50)	0.68	(0.47)	0.53	(0.50)
Observations (student-years)	2467416		32485		67077	

Note: Means for dependent variables are based on varying sample sizes. Observations in student-years are based on independent variables.

Table 3.3 Effect of Attending a Charter School on Absences, Unexcused Absences and Tardies (Grade 3-12, 2006-2009)

Outcomes		Absences			Unexcused Absences			Tardies	
Models		Coef.	SE		Coef.	SE		Coef.	SE
Pooled OLS									
	Charter School	-0.46	(0.04)	***	-0.14	(0.03)	***	0.03	(0.04)
Random Effects									
	Charter School	-0.46	(0.04)	***	-0.11	(0.03)	***	0.03	(0.05)
Fixed Effects									
	Charter School	-0.28	(0.07)	***	0.17	(0.07)	*	0.09	(0.13)
Observations (student-years)		1955402			1523546			1393502	

Note: All models include grade and grade-squared. Additional control variables include LEP status, race, gender, free/reduced price lunch eligibility, disability status, academic giftedness, Title 1 school, and structural/non-strucutural change indicators. Robust SEs are in parentheses.

*Statistically significant at the 5% level **Statistically significant at the 1% level

***Statistically significant at the .1% level

Table 3.4 Effect of Attending a Charter School on Number and Days of In-School and Out-of School Suspensions (Grades 3-12, 2006-2009)

Outcomes		**Number of In-School Suspensions**			**In-School Suspension Days**			**Number of Out-of-School Suspensions**			**Out-of-School Suspension Days**		
Models		Coef.	SE		Coef.	SE		Coef.	SE		Coef.	SE	
Pooled OLS													
	Charter School	-0.43	(0.00)	***	-0.25	(0.00)	***	-0.17	(0.00)	***	-0.62	(0.01)	***
Random Effects													
	Charter School	-0.43	(0.00)	***	-0.24	(0.00)	***	-0.16	(0.00)	***	-0.62	(0.01)	***
Fixed Effects													
	Charter School	-0.48	(0.03)	***	-0.26	(0.01)	***	-0.19	(0.02)	***	-0.92	(0.08)	***
Observations (student-years)		1321549			1321549			1434224			1434224		

Note: All models include grade and grade-squared. Additional control variables include LEP status, race, gender, free/reduced price lunch eligibility, disability status, academic giftedness, Title 1 school, and structural/non-strucutural change indicators. Robust SEs are in parentheses.

*Statistically significant at the 5% level **Statistically significant at the 1% level ***Statistically significant at the .1% level

CHAPTER 4: ARE CHARTER SCHOOLS RETAINING EFFECTIVE TEACHERS?: EVIDENCE FROM NORTH CAROLINA

Introduction

While there is mounting evidence that teachers are essential to increasing student achievement and improving the U.S. education system (Hanushek, Kain, O'Brien, & Rivkin, 2005; Jackson, 2012; Rockoff, 2004; Aaronson, Barrow, & Sander, 2007), young adults continue to feel ambivalent about joining the profession. High quality, effective teachers increase academic achievement of students from any ability level and have the largest positive impact on low-performing students (Aaronson et al., 2007; Hanushek et al., 2005). However, teachers continue to earn significantly less than their peers in comparable professions (Allegretto, Corcoran, & Mishel, 2004), and the average teacher salary has decreased over 15 percent, adjusting for inflation, since 2004. In particular, for the past 5 years, teacher turnover in North Carolina has continued to increase (NCDPI, 2015), and North Carolina has the lowest per student expenditure rates in the US (NEA, 2015).

Since charter school legislation was first passed in 1991, charter schools have become a popular alternative to TPSs and are touted as the best solution to fixing the US education system. One of the key theoretical explanations for why charter schools should be effective at increasing student achievement is their potential as incubators of innovation. Most notably, charter schools can develop their own organizational and staffing policies (Stuit & Smith, 2012; Cowen & Winters, 2013). These alternative policies are the key to attracting and retaining effective teachers since they simultaneously give teachers more flexibility to perfect their teaching style

while also giving school administrators the ability to remove ineffective teachers and award effective teachers.

This study examines whether charter schools are more likely to retain effective and high quality teachers than TPSs. Using data from North Carolina, I first quantify a teacher's effectiveness using a valued added model (VAM). Then, using a multinomial logit, I evaluate if high quality charter school teachers are more likely to remain in their particular school than high quality TPS teachers. Previous research in Florida has shown that there is no difference in teacher effectiveness and teacher exit between charter schools and TPSs. Besides using data from North Carolina, I build on this Florida study by using a more stringent VAM to evaluate teacher effectiveness. This study adds to the growing literature on understanding the characteristics of charter schools that negatively or positively affect student achievement (Betts & Loveless, 2005; Gill, Timpane, Ross, & Brewer, 2001; Zimmer et al., 2003).

Background: Charter Schools in North Carolina

In 1996, North Carolina legislators passed the Charter Schools Act allowing for the development of 100 charter schools. Thirty-four charter schools opened the following school year. In 2011, the 100 charter school cap was lifted, so that currently there are 158 charter schools in North Carolina. About four percent of North Carolina's school-age population attends charter schools while, within each county, the percent of the student population enrolled in a charter school ranges from zero to 16 percent (See Figure 3.1).

Charters schools are one form of school choice that decentralizes public education. Local, state, and federal funds support charter schools, with state funds being their primary source of support. Unlike TPSs, charter school enrollment is not restricted by a student's residence, and charter schools develop their own policies and regulations. A charter school's board of directors

is in charge of the budget, curriculum, and other opertaional activities. For example, the school board is not required to provide transportation or meals to students, even students eligible for free or reduced price lunch.

Charter schools in North Carolina also follow different guidelines when hiring and recruiting teachers. The North Carolina Charter School Application Resource Manual (2015) states that charter schools have the ability to:

> "…purchase off state contract [unless using certain federal funds with requirements placed upon these funds by the federal government, i.e. Race to the Top Funding]; hire non-certified teachers [with percentage limits and in accordance with NCLB criteria]; hire teaching personnel on at-will contracts; and negotiate personnel salaries."[8]

As suggested above, charter schools develop their own policies from teachers' vacation time to health insurance to retirement benefits (See Figure 3.2 for a complete list). Additionally, teachers at charter schools do not have to be licensed; fifty percent of middle and high school teachers and 25 percent of elementary school teachers can be unlicensed (Office of Charter Schools, 2015).

Charter school teachers are given more leeway in determining how they perform daily operations compared to TPS teachers. One specific purpose of charter schools in North Carolina is to "create new professional opportunities for teachers" (§ 155C-238.29a(4)[9]; see Carruthers, 2012). While charter school and TPS teachers are still held accountable for ensuring that their

[8]See http://www.ncpublicschools.org/docs/charterschools/applications/resourcemanual.pdf.

[9]North Carolina General Statutes. § 155C-238.29a(4). See www.ncga.state.nc.us/enactedlegislation/statutes/html/bysection/chapter_115C/gs_115c-238.29a.html.

students' academic achievement increases, charter school teachers can structure their lesson plans, curriculum, and other educational opportunities in whichever way they believe will be most beneficial to their students. Charter school teachers are encouraged to think innovatively and try new teaching techniques.

Theoretical Considerations

Several theories explain why effective charter school and TPS teachers may be attracted to teach in their respective school types. Market theory purports that charter schools, as a form of school choice, "stimulate the development and improvement of schools through market competition" (Friedman, 1962; Chubb & Moe, 1990). Charter schools are theoretically of higher quality than TPSs because they are incentivized to be innovative. In competing for students, charter school must offer a better product, or education. School choice and competition leads to a faster rate of innovation since schools have to stay focused on providing a superior education (Becker, 1999; Friedman, 1955; Chubb & Moe, 1990; Coulson, 1999; Friedman & Friedman, 1980; Gintis, 1995; Lubienski, 2005). Teachers, consequently, will be incentivized to find the most effective teaching techniques and thus be more effective overall. Unregulated charter schools provide teachers with the autonomy to innovate and improve student outcomes (Miron & Applegate, 2007; Mintrom, 2000).

Market theory predicts charter schools attract better teachers relative to TPSs. Similar to how charter schools induce schools to compete for students, they also compel them to compete for teachers. Charter schools offer teachers a variety of different benefits, salary levels, and working environments. Additionally, an extension of this research finds that teachers are less likely to leave if they have more autonomy and decision-making power (Ingersoll, 2001; Smith & Rowley, 2005). In contrast, teachers in highly regulated and systematized TPSs have little

incentive to improve or even maintain a certain standard of quality (Chubb & Moe, 1990). The presence of charter schools allows teachers a greater variety of employment options. Overall, charter schools can offer teachers competitive wages and benefits while also providing them with the freedom to innovate and develop their professional competencies.

However, despite the increased autonomy and benefits, the particular organizational characteristics of charter schools can discourage teachers. Several studies have found that charter school teachers are quickly "burning out" due to their high workload and long work days (Hubbard & Kulkarni, 2009; Malloy & Wohlstetter, 2003; Vasadeva & Grutzik, 2002; Weiss, 1997). Teacher burnout not only plagues new charter schools but also those that have operated for several years (Finn, Manno, & Vanourek, 2000). These conditions may induce even effective and motivated teachers to leave.

According to new institutional theory, a subset of organizational theory, charter schools will not be markedly different from TPSs. New institutional theory assumes that organizations, such as schools, are highly regulated and static (DiMaggio & Powell, 1983) due to the overwhelming influence of an organization's history (North, 1990). Communities with strong values implicitly define what is considered to be a legitimate school. In order to be successful, new schools are strongly incentivized to adopt similar norms and structures that validate and legitimize existing customs. Ultimately, this leads to organizational isomorphism (Meyer & Ramirez, 2000; Meyer & Rowan, 1977) and suggests that charter schools would ultimately revert back to more traditional learning systems without innovative practices (Lubienski, 2005).

Literature Review

Teacher Effectiveness and Exit

Previous research showed that more "highly qualified" teachers, determined using teacher credentials, test scores, and education, were more likely to leave the teaching profession (Boyd, Lankford, Loeb, & Wyckoff, 2005; Goldhaber & Hansen, 2009; Podursky, Monroe, & Watson, 2004; Lankford, Loeb, & Wyckoff, 1999). Teachers with the highest scores on their general certification exams or who were National Board for Professional Teaching Standard certified were more likely to exit schools with low performing students (Boyd et al., 2005; Goldhaber & Hansen, 2009). Academically gifted teachers, such as teachers that attended highly selective colleges or received high ACT scores, were also more likely to leave schools with low SES student bodies and exit the teaching profession (Podursky et al., 2004; Lankford et al., 2002). However, these easily measurable teacher qualifications only had a weak relationship with student achievement making the results from these studies weaker than those that used VAMs to estimate teacher effectiveness (Aaronson et al., 2007; Clotfelter, Ladd, & Vigdor, 2007; Goldhaber & Brewer, 2001; Gordon, Kane, & Staiger, 2006; Hanushek, 1986, 1997).

Recent studies using VAMs to quantify teacher effectiveness have found the opposite results. Data analyzed from North Carolina, Texas, and Florida consistently showed that ineffective teachers in TPSs were the most likely to leave the teaching profession (Boyd et al., 2008; Feng & Sass, 2008; Goldhaber, Gross, & Player, 2011; Krieg, 2006; Hanushek, Kain, & Rivkin, 2004; West & Chingos, 2009). These results were true across all school subjects. A study of high school math and science teachers showed that teachers who remained in the teaching

profession after at least 5 years of teaching were more effective than teachers who left earlier (Henry, Fortner, & Bastian, 2012). Additional research showed similar results for math and English teachers in grades 3 through 12 (Henry, Bastian, & Fortner, 2011). Because these estimates were based on student test scores, they were a better reflection of teacher effectiveness.

Charter School Teachers

Several studies showed that charter school teachers demographically differed from TPS teachers. Specifically, charter school teachers were less experienced, younger, and less licensed (Carruthers, 2012; Epple, Romano, & Zimmer, 2015; Miron & Applegate, 2007; Stuit & Smith, 2012). On average, charter school teachers had 3.6 years of teaching experience while TPS teachers have about 8.1 years of teaching experience (Epple et al., 2015), and about a third of charter school teachers were under the age of 30 (Stuit & Smith, 2012). However, charter schools were also more likely to hire teachers from highly competitive undergraduate institutions (Baker & Dickerson, 2006) although charter school teachers were less likely than TPS teachers to have graduate level degrees (Epple et al., 2015). Additionally, while all TPSs required their teachers to be licensed, the majority of charter schools did not have licensing requirements.

Charter schools typically had significantly higher teacher turnover rates than TPSs (Cowen & Winters, 2013; Miron & Applegate, 2007; Podgursky & Ballou, 2001; Smith & Ingersoll, 2004; Stuit & Smith, 2012). Research in Florida and North Carolina indicated that charter school teachers were twice as likely to leave compared to TPS teachers (Carruthers, 2012; Cowen & Winters, 2013). Similarly, a multistate study showed charter school teacher turnover typically ranged from 15 to 40 percent while TPS teacher turnover ranged from only 11 to 14 percent (Miron & Applegate, 2007). Most studies attributed the high teacher turnover rate to the younger, less experienced, and less certified teacher population in charter schools (Miron &

Applegate 2007; Stuit & Smith, 2012). In terms of teacher effectiveness, the least effective charter school teachers were more likely to exit, mirroring findings found on TPS teacher exit (Cowen & Winters, 2013).

Few studies evaluted charter schools teachers in North Carolina. Using a sample of TPSs teachers, Jackson (2012) examined how the building and establishment of charter schools influenced teacher retention. He found that TPSs with low-income, high-minority populations experienced a small decrease in teacher quality when charter schools were built in the same vicinity as TPSs. However, Carruthers (2012) found that charter schools were more likely to draw away and hire less effective TPS teachers. In other words, less effective TPS school teachers were leaving TPSs to teach instead at a charter school. The present study builds upon this research by comparing the movement of charter school and TPS teachers.

Data

Data in this study comes from the North Carolina Department of Public Instruction (NCDPI) administrative records. These data are maintained by the North Carolina Education Research Data Center (NCDERC) and includes state-wide information on North Carolina's students, teachers, classrooms, schools, and districts. Students are longitudinally linked and therefore can be followed from year to year. Additionally, students are linked to teachers who proctored their End-of-Grade math and reading exams.

The analytic sample includes TPS and charter school teachers for grades 4 and 5 from the 2008-2009 and 2009-2010 school years. I restricted my sample to teachers in self-contained classrooms to ensure that the student-teacher link provided a good match between students and their actual classroom teacher. Additionally, the NCERDC only recently started collecting data on self-contained classrooms of charter school teachers which limited this analysis to two years

of data. Finally, teachers linked to less than 10 students in a given year were dropped from analysis to ensure an accurate estimate of teacher quality was calculated.

Methods

Estimating Teacher Effectiveness

Teachers' level of effectiveness per year was estimated using a VAM and adjusted by an empirically Bayesian shrinkage factor (Kane & Staiger, 2002; Jacob & Lefgren, 2008). Specifically, the VAM employed was a 3-level hierarchical linear model, a type of nested random effects model. Random effects models control for a rich amount of student, classroom, and school characteristics. I estimate teacher's effectiveness separately for each year since previous studies show that teacher effectiveness can vary substantially from year to year (Sass, 2006; Koedel & Betts, 2011). A previous study comparing 9 types of VAMs shows that 3-level hierarchical linear models including a least one pretest score provided the most reliable estimates of teacher effectiveness (Rose, Henry, & Lauen, 2012).

In my model, students were nested within classrooms within schools. VAMs numerically evaluate the contribution a teacher makes to a student's achievement:

$$(1)\ Y_{ijst} = \beta_0 + \beta_1 Y_{it-1} + \beta_2 \mathbf{X}_{ijst} + \beta_3 \mathbf{C}_{jst} + \beta_4 \mathbf{S}_{st} + \phi_{jst} + \varepsilon_{ijst}.$$

Subscripts *i, j, s,* and *t* index the student, teacher, school, and year, respectively. The dependent variable, Y_{ijst}, represents students' End-of-Grade standardized math or reading test scores. To control for past inputs and innate ability, students' one year prior standardized test score, Y_{it-1}, was included (Carruthers, 2012; Koedel & Betts, 2011). Kane and Staiger (2008) found that specifications including lagged achievement yielded teacher effect estimates comparable to the estimates found under experimental settings where teachers are randomly matched to students. Vectors **X**, **C**, and **S** represent student-, classroom-, and school-level covariates, respectively.

Student-level covariates included indicators of sex, race, academic giftedness, learning disability, eligibility for free/reduced price lunch (FRPL), limited English proficient (LEP) status, and movement to another school. A covariate estimating peer ability, measured by averaging the test scores of a student's previous classmates was included, which addressed violating the stable unit treatment value assumption, or SUTVA (Rose et al., 2012). SUTVA states that the treatment effect will not change depending on the composition of a teacher's classroom (Rubin, Stuart, & Zanutto, 2004). Classroom covariates consisted of class size, percent FRPL, and percent LEP. School-level measures included average school enrollment, enrollment squared, percent FRLP, Title I eligibility, crimes per 100 students, percent black, percent Hispanic, and percent white, and school location (i.e. urban, suburban, town, or rural). Lastly, ϕ_{jst} was the estimated teacher effect. Year fixed effects were also included in this model.

Estimating Teacher Movement

To estimate whether effective charter school teachers are more or less likely to exit their respective schools, I employed a multinomial logit (MNL) model. MNL models describe the conditional probability that a teacher makes one of the two types of moves described, relative to the probability of remaining in her or his given school, as:

$$(2)\ P(Y_i=m)=\frac{\exp(Z_{mijt})}{1+\sum_m^M \exp(Z_{mijt})}$$

where

$$Z_{mjst}= \gamma\phi_j + \pi_1\mathbf{X}_j + \pi_3\mathbf{S}_{s,t-1} + \tau_t + e_{jst.}$$

The dependent variable, Z_{mjst}, represents a teachers' move and indicates if a teacher was retained by his or her school (=1), exited the school system (=2), or transferred to another school (=3). Vectors **X** and **S** represent teacher- and school-level covariates, respectively. The two key independent variables include teacher's effectiveness (ϕ_j) and a charter school indicator (one of

the school-level covariates included in vector **S**). Teacher covariates include sex, race, and class size. School covariates include average enrollment, enrollment squared, percent FRPL, Title I eligibility, crimes per 100 students, percent black, percent Hispanic, percent white, and school location (i.e. urban, suburban, town, and rural). Year-fixed effects were also included (τ).

Because the outcome is a categorical indicator, results include coefficients for each covariate in reference to the base category. For example, since the base category is teacher retained, and I expect more effective teachers to be retained, the teacher effectiveness coefficient should be negative and statistically significant. If less effective teachers are retained, the teacher effectiveness coefficient should be positive and statistically significant. Additionally, if charter schools are more likely to retain teachers (and the base category is still teacher is retained), the charter school indicator coefficient will be negative and statistically significant.

I also run another multinomial logit which includes an interaction term between the covariates measuring teacher effectiveness and indicating a charter school. This interaction term illustrates whether the relationship between teacher effectiveness and teacher exit dramatically differs between charter and TPSs. In other words, if the interaction term is statistically significant for either type of teacher exit indicated by my two outcome categories, this will confirm that there is a substantial difference in the types of teachers (in terms of their effectiveness) exiting TPSs and charter schools.

A linear probability model (LPM) was included as a sensitivity check. LPMs use dummy variables as their dependent variable and help predict the likelihood of each type of exit. For the LPM used in this study, the outcome variable indicated if a teacher was retained the following year. The MNL was used as the main model since there are a few problems with LPM models. First, a LPM model, by definition, has heteroskedastic and thus unreliable standard errors.

Second, predictions from a LPM model may fall out of the 0 to 1 range. Thus, some of the predictions may not be accurate. While the LPM model is useful to check the robustness of my results, the estimates from the MNL model will be more consistent overall.

While both student's math and reading test scores were used to calculate teacher effectiveness, I only present the results using the math test scores since the reading test scores results were similar unless otherwise noted.

Results

My analysis begins by observing the differences in school characteristics and teacher mobility rates between charter schools and TPSs. In general, charter schools seem to have more positively selected characteristics than TPSs (Table 4.1). Charter schools enroll fewer students (427 versus 519), have less crime per 100 students (.14 versus .16), a higher proportion of white students (56% versus 52%) and a lower proportion of Latino students (4% versus 13%) compared to TPSs. However, TPSs have a smaller proportion of black students. Most charter schools are located in urban areas (42%) while most TPSs are found in rural locations (48%). Finally, TPS teachers are, on average, more effective than charter school teachers (.00 versus -.02, not reported in table). The majority of both charter school (63%) and TPS teachers (68%) remain in their respective schools (Table 4.2). Slightly more charter school teachers exit the North Carolina school system than TPS teachers (35.2% versus 28.3%). Finally, a small proportion of charter and TPS teachers transfer to other schools (1.9% and 3.7%, respectively).

While the average teacher and classroom characteristics are similar among teachers who remain in their school, exit their school, and switch schools, the overall school characteristics among these groups differ (Table 4.3). The majority of 4th and 5th grade teachers in North Carolina's public school system are white (85%) and female (89%). The average class size is 22

children, the majority of students are white (55%), and almost a third are black (29%). Teachers remain in schools that have less crime, fewer students eligible for free and/or reduced price lunch, fewer black students, and more white students. Additionally, these teachers are, on averager, more effective. Teachers are more likely to exit schools that are Title 1 eligible and that enroll fewer students. Teachers exiting the school system are also the least effective. Also, teachers are more likely to transfer from schools that have higher proportions of black and Hispanic students.

The MNLs show that compared to teachers who transfer schools or exit the school system, effective teachers are more likely to be retained (Table 4.4). In other words, the least effective teachers are more likely to leave schools or transfer to another school. However, there is no statistically significant difference between charter school and TPS teachers in terms of their decision to exit or remain in their respective schools. Similarly, there is no difference between charter school and TPS teachers in their decision to transfer schools compared to remaining in their respective schools. Additionally, the MNL with the interaction effect confirms these results since the relationship between teacher effectiveness and teacher exit (or teacher transfer) does not appear to differ significantly by school sector. Similar results for the reading sample were found, although the effectiveness coefficient was only statistically significant for the teacher exit category (See Appendix Table C1). Finally, the robustness of my results were confirmed by a linear probability model (See Appendix Table C2).

Discussion

In North Carolina, charter schools appear to differ from TPSs in terms of their overall school characteristics. In contrast, teacher-level and classroom-level characteristics among charter schools and TPSs are almost the same. My analysis shows that high-performing teachers,

as measured by VAMs, are more likely to remain in their schools than low quality teachers. Additionally, despite the differences in school characteristics among charter and TPSs, there is no difference between charter school and TPS teachers in terms of movement among schools. In other words, charter schools are no better than TPSs at retaining effective teachers.

The results of this study support the theory of organizational isomorphism, or the idea that charter schools are, in fact, organizationally similar to TPSs. Charter schools do not appear to be retaining more effective teachers than TPSs. This remains true despite previous studies showing that, demographically, charter school teachers differ from TPS teachers (Carruthers, 2012; Epple et al., 2015; Miron & Applegate, 2007; Stuit & Smith, 2012). In other words, the organizational characteristics of schools are making demographically different teachers conform to a certain standard. As seen in Table 4.1, although charter schools seem to have more valued school characteristics, the day-to-day classroom characteristics are similar between school sectors.

This study has several policy implications. The NC legislature recently voted to phase out the teacher tenure system in TPSs and replace it with a tiered contract system. Other states, such as Florida and Louisiana, have already repealed their teacher tenure policies. Advocates of tenure systems argue that tenure ensures schools keep their best teachers. However, my results show that the most effective teachers remain in their schools, whether it is a charter, which do not typically have tenure systems, or TPS, which (until recently) had tenure systems. In other words, effective teachers are already more likely to stay in schools, even if tenure is not available.

However, my analysis shows that teacher turnover in North Carolina is still relatively high in both charter schools and TPSs. Policies and programs need to be implemented to attract and retain more effective teachers into both North Carolina's TPSs and charter schools. Teachers

are more likely to remain in schools with small class sizes, administrative suppport, and opportunities for professional advancement (Carter & Carter, 2000; Ingersoll, 2001; Whitener et al., 1997). Additionally, past studies examining the soft reasons that teachers remained in their schools include having autonomy, agreeing with a school's mission, feeling supported by the principal, and working with likeminded educators (Stuit and Smith, 2012; Cannata & Penaloza, 2012). These intangible facets of schools should continue to be evaluated.

The results of this study are not without limitations. First, some teacher-level covariates such as years of experience, education, and licensure are not included in my analysis since they are absent from the data set for charter school teachers. Because teachers are not randomized into charter schools, teachers in charter schools substantially differ from TPS teachers; TPS teachers tend to be older, are licensed, and more educated (Carruthers, 2012; Epple, Romano, & Zimmer, 2015; Miron & Applegate, 2007; Stuit & Smith, 2012). In models estimating teacher exit, estimates may be upwardly biased since one would assume that TPS teachers are more likely to be near retirement age and have more opportunities outside of teaching due to their higher levels of education. However, my results show that this is not necessarily the case; charter school teachers are just as likely to exit their school as TPS teachers. Of course, my results should be interpreted cautiously since omitted variable bias is still a serious conceptual and empirical issue for both analyzing school effects and evaluating policies.

Second, only two years of data could be included in my analysis due to key variables missing for other school years. Future research should include several more years of data. This would not only confirm and strengthen these current findings but would also allow for using other types of VAMs (i.e. teacher fixed effects) to calculate teacher effectiveness. Lastly, VAMs are only one way to measure teacher effectiveness, and researchers suggest that they only be

used for low stakes purposes (Rose et al., 2012). Consequently, future research should also employ other measures of teachers' effectiveness such as teacher's years of experience or education.

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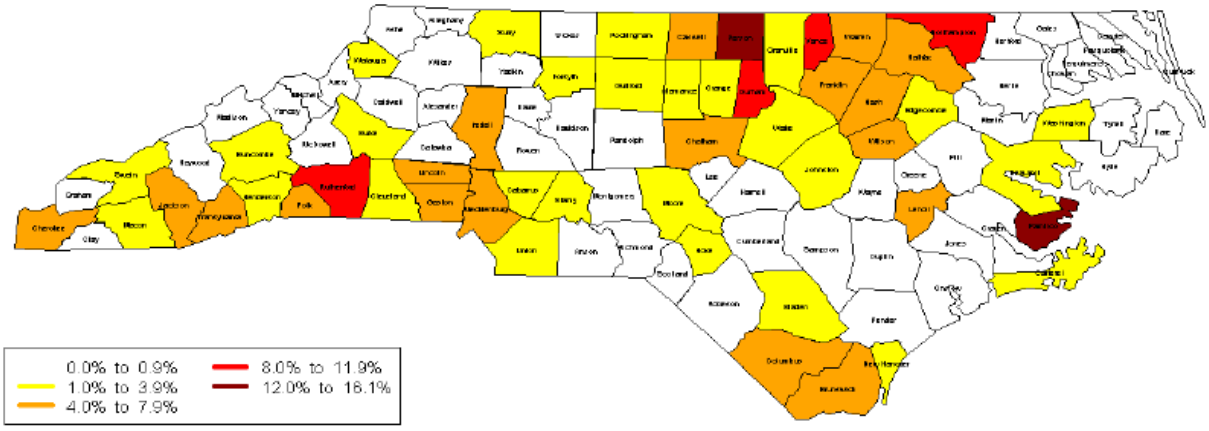

Source: http://www.ncpublicschools.org/docs/charterschools/membershipmap11-12.pdf

Figure 4.1: Percentage of Students in Charter School Membership (2011-2012)

LEAVE BENEFITS	Jury Duty
Vacation (based on state service)	Court Attendance (not for personal reasons)
Vacation for Catastrophic Illness	Military Leave & Possible Differential Pay
Vacation for Newborn, Adoptive or Foster Child	Professional/Educational
Sick (one day per month)	**OTHER BENEFITS**
Personal	Retirement
20 Day Extended Sick	Death Benefit
Paid Holidays	Disability
Voluntary Shared Leave	Longevity
Sick Leave for Adoption (up to 30 days)	Health Insurance
FMLA (if emp. 1 yr & if 1,250 hrs in last 12 mos)	Professional Liability Insurance
Parental Involvement	Tenure
Episode of Violence	Comp.Time/Overtime (If FLSA non-exempt)
Contagious Disease	Social Security
Susp. with Pay (investigation/dismissal)	Workers' Comp.
Community Responsibility	Unemployment Insurance
Meetings for SBE, Gov., etc.	
Notes: These benefits apply to full time permanent teachers. Charter school employee benefits are determined by the charter schools' Board of Directors. Information retrieved from http://www.ncpublicschools.org/humanresources/district-personnel/key-information/	

Figure 4.2: Benefits Set by NC for TPS Teachers (2012)

Table 4.1 North Carolina Elementary School Descriptives (2009-2010)

	Traditional Public School		Charter School	
	%/mean	SD	%/mean	SD
Average Enrollment	519	201	427	302
% Female	49%	0.03	50%	0.05
Title 1 School	76%	0.43	58%	0.50
Crimes per 100 Students	0.16	0.43	0.14	0.42
Ethnic Composition				
% Black	32%	0.25	36%	0.34
% Latino	13%	0.12	4%	0.06
% White	52%	0.29	56%	0.36
Location				
Urban	26%	0.44	42%	0.50
Suburban	13%	0.34	12%	0.32
Town	12%	0.33	18%	0.39
Rural	48%	0.50	28%	0.45
Observations (school-years)	2511		138	

Table 4.2. Teacher Mobility Rates, by Sector (2009-2010)

	TPS (%)	Charter (%)
No Move	68.0%	63.0%
Transferred Schools	3.7%	1.9%
Exit Data	28.3%	35.2%
Observations (teacher-years)	12307	162

Table 4.3 Description of 4th and 5th Grade Teachers by Type of Move

	Total Sample		No Move		Transfer		Exiting System	
	%/mean	SD	%/mean	SD	%/mean	SD	%/mean	SD
Teacher Characteristics								
Effectiveness	0.00	(0.16)	0.01	(0.16)	-0.01	(0.16)	-0.02	(0.16)
Female	89%	(0.31)	90%	(0.31)	90%	(0.30)	89%	(0.31)
Race								
Asian	1%	(0.07)	1%	(0.08)	0%	(0.07)	0%	(0.06)
Black	13%	(0.34)	13%	(0.33)	17%	(0.37)	14%	(0.34)
Hispanic	1%	(0.08)	0%	(0.07)	0%	(0.07)	1%	(0.09)
American Indian	1%	(0.08)	0%	(0.07)	0%	(0.05)	1%	(0.10)
Multiracial	0%	(0.05)	0%	(0.05)	1%	(0.08)	0%	(0.05)
White	85%	(0.36)	85%	(0.35)	82%	(0.39)	84%	(0.37)
Classroom Characteristcs								
Class size	22	(3.65)	22	(3.59)	21	(3.64)	21	(3.79)
% LEP	6%	(0.01)	6%	(0.01)	6%	(0.01)	6%	(0.01)
% FRLP	50%	(0.07)	50%	(0.07)	51%	(0.07)	50%	(0.07)
Ethnic Composition								
% Black	29%	(0.05)	29%	(0.05)	30%	(0.05)	29%	(0.05)
% Latino	9%	(0.01)	9%	(0.01)	10%	(0.01)	9%	(0.01)
% White	55%	(0.06)	55%	(0.06)	54%	(0.06)	54%	(0.06)
School Characteristcs								
Average Enrollment	571	(200)	576	(198)	576	(237)	560	(199)
% FRLP Eligible	54%	(0.23)	53%	(0.23)	60%	(0.24)	57%	(0.23)
Title 1 School Eligible	75%	(0.43)	73%	(0.44)	75%	(0.43)	79%	(0.41)
Crimes per 100 Students	0.16	(0.41)	0.15	(0.40)	0.24	(0.57)	0.18	(0.43)
Ethnic Composition								
% Black	33%	(0.24)	31%	(0.23)	41%	(0.26)	34%	(0.25)
% Hispanic	13%	(0.12)	13%	(0.12)	15%	(0.13)	13%	(0.13)
% White	51%	(0.28)	52%	(0.28)	41%	(0.29)	48%	(0.29)
Location								
Urban	29%	(0.45)	29%	(0.45)	41%	(0.49)	28%	(0.45)
Suburban	15%	(0.36)	16%	(0.37)	14%	(0.34)	14%	(0.34)
Town	12%	(0.33)	11%	(0.32)	10%	(0.30)	15%	(0.36)
Rural	43%	(0.50)	44%	(0.50)	36%	(0.48)	43%	(0.50)
Observations (teacher-years)	12496		8469		459		3541	

Table 4.4 Predicting Teacher Mobility using Multinomial Logits (Math Sample)

	Without Interaction				With Interaction			
	Transfer		Exit Data System		Transfer		Exit Data System	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Key Independent Variables								
Teacher Effectiveness	-0.70	(0.30) *	-1.12	(0.13) ***	-0.69	(0.30) *	-1.13	(0.14) ***
Charter School	-0.95	(0.62)	0.18	(0.22)	-1.04	(0.68)	0.18	(0.22)
Charter School*Effectiveness					-1.93	(4.77)	0.24	(1.02)
Teacher Characteristics								
Female	0.14	(0.15)	-0.02	(0.07)	0.14	(0.15)	-0.02	(0.07)
Class size	0.00	(0.02)	-0.01	(0.01)	0.00	(0.02)	-0.01	(0.01)
Race								
Asian	-0.60	(0.74)	-0.52	(0.32)	-0.60	(0.74)	-0.52	(0.32)
Black	-0.23	(0.16)	-0.08	(0.07)	-0.23	(0.16)	-0.08	(0.07)
Hispanic	-0.30	(0.76)	0.65	(0.30) *	-0.30	(0.76)	0.65	(0.30) *
American Indian	-1.40	(1.09)	0.14	(0.29)	-1.40	(1.09)	0.14	(0.29)
Multiracial	0.45	(0.64)	-0.38	(0.41)	0.45	(0.64)	-0.38	(0.41)
White (ref.)								
School Characteristcs								
Average Enrollment	0.00	(0.00) ***	0.00	(0.00)	0.00	(0.00) ***	0.00	(0.00)
Average Enrollment Squared	0.00	(0.00) ***	0.00	(0.00)	0.00	(0.00) ***	0.00	(0.00)
% Free/Reduced Price Lunch Eligible	0.61	(0.45)	0.27	(0.24)	0.62	(0.45)	0.27	(0.24)
Title 1 School Eligible	-0.07	(0.20)	0.06	(0.09)	-0.07	(0.20)	0.06	(0.09)
Crimes per 100 Students	0.27	(0.16)	0.12	(0.07)	0.27	(0.16)	0.12	(0.07)
Ethnic Composition								
% Black	-0.64	(0.97)	-0.79	(0.47)	-0.64	(0.97)	-0.79	(0.47)
% Hispanic	-1.21	(1.01)	-1.22	(0.52) *	-1.21	(1.01)	-1.22	(0.52) *
% White	-1.78	(0.93) *	-1.22	(0.44) **	-1.78	(0.93) *	-1.22	(0.44) **
Location								
Urban (ref)								
Suburban	-0.09	(0.21)	0.06	(0.11)	-0.09	(0.21)	0.06	(0.11)
Town	-0.20	(0.25)	0.38	(0.11) ***	-0.21	(0.25)	0.38	(0.11) ***
Rural	-0.14	(0.17)	0.16	(0.08) *	-0.14	(0.17)	0.16	(0.08) *
Observations (teacher-years)	12469		12469		12469		12469	

Notes: Standard errors are clustered by school, and models include year fixed effects.

*Statistically significant at the 5% level **Statistically significant at the 1% level ***Statistically significant at the .1% level

APPENDIX A: ADDITIONAL RESULTS FROM CHAPTER TWO

Appendix Table A1. Linear Multilevel Growth Models, 2004-2011

	Math Standardized Test Score		Reading Standardized Test Score	
	Coef.	SE	Coef.	SE
Charter School	-0.13	(0.00) ***	-0.03	(0.00) ***
Grade	-0.02	(0.00) ***	-0.01	(0.00) ***
Charter School X Grade	0.04	(0.00) ***	0.04	(0.00) ***
Structural Change				
Non-Structural Change	-0.02	(0.00) ***	-0.02	(0.00) ***
Structural Change	-0.06	(0.00) ***	-0.03	(0.00) ***
No Change (ref.)				
Demographics				
Female	-0.03	(0.00) ***	0.13	(0.00) ***
Free/Reduced Price Lunch	-0.17	(0.00) ***	-0.20	(0.00) ***
Retention	0.23	(0.01) ***	0.17	(0.01) ***
Limited English Proficient	-0.41	(0.00) ***	-0.54	(0.00) ***
Disability Status	-0.27	(0.00) ***	-0.43	(0.00) ***
Academic Giftedness	0.54	(0.00) ***	0.50	(0.00) ***
Race				
Asian	0.33	(0.01) ***	0.11	(0.01) ***
Black	-0.66	(0.00) ***	-0.60	(0.00) ***
Hispanic	-0.20	(0.00) ***	-0.27	(0.00) ***
American Indian	-0.53	(0.01) ***	-0.53	(0.01) ***
Multiracial	-0.25	(0.00) ***	-0.21	(0.00) ***
White (ref.)				
Observations (student-years)	3861493		3843599	

Note: Grade recentered at 0. Models include interactions between student demographic controls and grade. Robust SEs in parentheses.

*Statistically significant at the 5% level **Statistically significant at the 1% level

***Statistically significant at the .1% level

Appendix Table B1. Effect on Charter Schools by Number of Years Student Enrolled in Charter School using Student FE Model (Grade 3-12, 2006-2009)

	Absences		Unexcused Absences		Tardies		Number of In-School Suspensions		Days of In-School Suspensions		Number of Out-of-School Suspensions		Days of Out-of-School Suspensions	
	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE	Coef.	SE
1st Year in Charter	-0.30	(0.09) **	0.24	(0.09) **	0.24	(0.15)	-0.31	(0.02) ***	-0.61	(0.03) ***	-0.20	(0.02) ***	-0.89	(0.12) ***
2nd Year in Charter	-0.68	(0.10) ***	-0.02	(0.11)	-0.90	(0.21) ***	-0.43	(0.02) ***	-0.82	(0.04) ***	-0.27	(0.02) ***	-1.17	(0.11) ***
3rd Year in Charter	-0.70	(0.13) ***	-0.20	(0.13)	-1.90	(0.25) ***	-0.59	(0.02) ***	-1.13	(0.04) ***	-0.40	(0.02) ***	-1.67	(0.14) ***
4th+ Year in Charter	-1.05	(0.19) ***	-0.48	(0.19) *	-3.05	(0.30) ***	-0.81	(0.02) ***	-1.53	(0.04) ***	-0.57	(0.03) ***	-2.39	(0.13) ***
Grade	-0.44	(0.03) ***	0.37	(0.03) ***	-0.92	(0.04) ***	0.11	(0.01) ***	0.22	(0.02) ***	0.10	(0.01) ***	-0.01	(0.04)
Grade x Grade	0.06	(0.00) ***	0.01	(0.00) **	0.05	(0.00) ***	0.01	(0.00) ***	0.01	(0.00) ***	0.01	(0.00) ***	0.06	(0.00) ***
Structural Change														
Non-Structural Change	-0.65	(0.02) ***	-0.27	(0.01) ***	-0.36	(0.02) ***	-0.01	(0.00)	0.01	(0.01)	-0.01	(0.00)	0.11	(0.02) ***
Structural Change	0.04	(0.01) **	0.14	(0.01) ***	-0.11	(0.01) ***	0.04	(0.00) ***	0.09	(0.01) ***	0.01	(0.00) **	0.09	(0.01) ***
No Change (ref.)														
Demographics														
Free/Reduced Price Lunch	0.42	(0.03) ***	0.22	(0.02) ***	-0.05	(0.03)	0.04	(0.01) ***	0.08	(0.01) ***	0.02	(0.01) ***	0.08	(0.02) ***
Limited English Proficient	0.48	(0.15) **	0.45	(0.14) **	0.07	(0.13)	0.01	(0.03)	0.01	(0.06)	0.01	(0.03)	0.14	(0.11)
Disability Status	-0.23	(0.05) ***	-0.06	(0.05)	-0.01	(0.06)	-0.04	(0.02) *	-0.07	(0.04) *	-0.04	(0.01) **	-0.22	(0.07) **
Academic Giftedness	0.05	(0.02) *	-0.12	(0.02) ***	0.04	(0.03)	-0.08	(0.01) ***	-0.14	(0.01) ***	-0.06	(0.00) ***	-0.23	(0.02) ***
Title I	-0.39	(0.02) ***	-0.20	(0.02) ***	-0.06	(0.02) **	-0.16	(0.00) ***	-0.28	(0.01) ***	-0.14	(0.00) ***	-0.54	(0.02) ***
Observations (student-years)	1957702		1524465		1394391		1322794		1322794		1435470		1435470	

Note: Robust SEs in parentheses.

*Statistically significant at the 5% level **Statistically significant at the 1% level ***Statistically significant at the .1% level

APPENDIX C: ADDITIONAL RESULTS FROM CHAPTER FOUR

Appendix Table C1. Predicting Teacher Mobility using Multinomial Logits (Reading Sample)

	Without Interaction				With Interaction			
	Transfer		Exit Data System		Transfer		Exit Data System	
	Coeff.	SE	Coeff.	SE	Coeff.	SE	Coeff.	SE
Key Independent Variables								
Teacher Effectiveness	-0.92	0.65	-1.91	0.29 ***	-0.91	0.65	-1.89	0.29 ***
Charter School	-0.93	0.62	0.20	0.22	-0.93	0.62	0.20	0.21
Charter School*Effectiveness					-0.14	8.83	-1.20	2.68
Teacher Characteristics								
Female	0.14	0.15	-0.02	0.07	0.14	0.15	-0.02	0.07
Class size	0.00	0.02	-0.01	0.01	0.00	0.02	-0.01	0.01
Race								
Asian	-0.58	0.74	-0.49	0.32	-0.58	0.74	-0.49	0.32
Black	-0.21	0.16	-0.06	0.07	-0.21	0.16	-0.06	0.07
Hispanic	-0.31	0.76	0.63	0.31 *	-0.31	0.76	0.63	0.31 *
American Indian	-1.38	1.09	0.19	0.30	-1.38	1.09	0.18	0.30
Multiracial	0.45	0.64	-0.40	0.42	0.45	0.64	-0.40	0.42
White (ref.)								
School Characteristcs								
Average Enrollment	0.00	0.00 ***	0.00	0.00	0.00	0.00 ***	0.00	0.00
Average Enrollment Squared	0.00	0.00 ***	0.00	0.00	0.00	0.00 ***	0.00	0.00
% Free/Reduced Price Lunch Eligible	0.61	0.45	0.27	0.24	0.61	0.45	0.27	0.24
Title 1 School Eligible	-0.07	0.20	0.06	0.09	-0.07	0.20	0.06	0.09
Crimes per 100 Students	0.27	0.16	0.11	0.07	0.27	0.16	0.11	0.07
Ethnic Composition								
% Black	-0.64	0.97	-0.78	0.46	-0.64	0.97	-0.78	0.46
% Hispanic	-1.20	1.01	-1.21	0.52 *	-1.20	1.01	-1.21	0.52 *
% White	-1.78	0.93 *	-1.21	0.44 **	-1.78	0.93 *	-1.20	0.44 **
Location								
Urban (ref)								
Suburban	-0.09	0.21	0.06	0.11	-0.09	0.21	0.06	0.11
Town	-0.20	0.25	0.38	0.11 **	-0.20	0.25	0.38	0.11 ***
Rural	-0.14	0.17	0.17	0.08 *	-0.14	0.17	0.17	0.08 *
Observations (teacher-years)	12469		12469		12469		12469	

Notes: Standard errors are clustered by school, and models include year fixed effects. Base category is teacher remains in school.

*Statistically significant at the 5% level **Statistically significant at the 1% level ***Statistically significant at the .1% level

Appendix Table C2. Predicting Teacher Retention Using LPM

	Math Sample			Reading Sample		
	Coef.	SE		Coef.	SE	
Key Independent Variables						
Teacher Effectiveness	0.23	0.03	***	0.38	0.06	***
Charter School	-0.02	0.05		-0.02	0.05	
Teacher Effectiveness*Charter School	-0.01	0.24		0.30	0.59	
Teacher Characteristics						
Class Size	0.00	0.00		0.00	0.00	
Female	0.00	0.01		0.00	0.01	
Race						
Asian	0.10	0.05	*	0.10	0.05	
Black	0.02	0.01		0.02	0.01	
Hispanic	-0.13	0.07		-0.12	0.07	
American Indian	-0.02	0.07		-0.02	0.07	
Multiracial	0.04	0.08		0.05	0.08	
White (ref.)						
School Characteristcs						
Average Enrollment	0.00	0.00	*	0.00	0.00	*
Average Enrollment squared	0.00	0.00	*	0.00	0.00	*
% Free/Reduced Price Lunch Eligible	-0.07	0.05		-0.07	0.05	
Title 1 School Eligible	-0.01	0.02		-0.01	0.02	
Crimes per 100 Students	-0.03	0.02	*	-0.03	0.02	*
Ethnic Composition						
% Black	0.18	0.11		0.18	0.11	
% Hispanic	0.28	0.12	*	0.28	0.12	*
% White	0.29	0.10	**	0.29	0.10	**
Location						
Urban (ref.)						
Suburban	-0.01	0.02		-0.01	0.02	
Town	-0.07	0.02	**	-0.07	0.02	**
Rural	-0.03	0.02		-0.03	0.02	
Observations (teacher-years)						

Notes: Standard errors are clustered by school, and models include year fixed effects.

*Statistically significant at the 5% level **Statistically significant at the 1% level

***Statistically significant at the .1% level