Twice Considered: Charter Schools and Student Achievement in Utah

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Abstract

A relatively small state, Utah presents an interesting case to study charter schools given its friendly policy environment for charter schools and its significant growth in both the number and the enrollment of charter schools. Although the population in Utah is increasingly diverse, charter school enrollment reflects a significantly lower portion of students of color and students from low-income families. Similar to many states, questions regarding the effectiveness and viability of charter schools continue to be a point of contention. Based on longitudinal student-level data from 2004 to 2009, this paper utilizes two alternative methodologies to evaluate the Utah charter school effectiveness: (a) hierarchical linear growth models with matched sample, and (b) student-fixed effects regressions. Both methods yield consistent results that charter schools on average perform slightly worse as compared to traditional public schools, a result that is primarily affected by the low effectiveness and high student mobility of newly-established charter schools. Interestingly, when charter schools gain more experience they become as effective as traditional public schools, and in some cases more effective than traditional public schools. Given the measured though continuous efforts to expand charter school options, this research has implications for local and state charter school policies, particularly policies that avoid "start-up" costs associated with new charter schools.

1. INTRODUCTION

The United States charter school movement has been driven by a multitude of arguments, including the necessity for market-based reforms to improve the quality of the current K-12 system of public education, the need for increased options for a dissatisfied customer base, and the ability of charter schools to educate children using less resources. Proponents of school choice argue that charter schools, as a market-based reform in education, will generate improved student outcomes without substantially increasing public expenditures. Importantly, advocates predict that school choice in general, and charter schools in particular, will benefit both students who actively choose their school—a direct effect—and non-choosers who remain behind in their assigned public schools—a systemic effect. Although both issues are equally important, the primary attention to date has been focused on the direct effect of charter schools, that is, how charter schools affect the achievement of the students who attend them.

Proponents of charter school policies argue that charter schools are more effective in improving student achievement than traditional public schools (TPSs) for several reasons. On the demand side of the market, one assumes that students would only attend a charter school if it were better or a better match than the student's assigned public school. As a result, one might expect the achievement of students who actively choose their schools to be superior to what it would have been had the student stayed in their assigned public school. On the supply side, charter schools are motivated to have high quality programs so that they can attract (and keep) more students, which will garner funding for them to survive and thrive.

In reality, research shows that parents and their children may select charter schools for reasons other than academic quality. For instance, curricular focus, extracurricular activities, safety, convenience, and perceived ability to affect decision making in the school often lead

families to choose charter schools. Even when parents do value school quality as a determining factor for choosing schools, they have to rely heavily on test scores, which are not the true measure of school quality (Hamilton & Guin, 2005). Today, parents' choice of schools is largely predicted by the student racial and socioeconomic composition of choice schools (Holme & Richards, 2009; Schneider, Teske, & Marscheall, 2000; Weiher & Tedin, 2002). Consequently, when choice is available, most parents prefer to send their child to a school where most students are similar to their child (Lacireno-Paquet & Brantley, 2008). While students benefit from attending schools with higher-achieving classmates, racially and socially isolated learning environments tend to negatively influence students' opportunities for success in academic achievement and later in the labor market (Cobb & Glass, 2009; Ladd, 2002).

Since large-scale charter school systems were implemented in the 1990s, there has been a substantial body of empirical research examining the relative effectiveness of charter schools and TPSs. Recent literature reviews on this issue, however, reveal the challenges of studying charter school effects. Among all the charter school achievement studies, only a few are considered methodologically rigorous. Of those that meet the standards of methodological rigor, most are longitudinal student-level studies in a handful of states and large cities (Betts & Tang, 2008; Miron, Evergreen, & Urschel, 2008; Teasley, 2009). Evidence from these studies regarding the effectiveness of charters for increased student performance is mixed. That is, depending on the student population served, operational years, and other factors, charter schools have produced negative, positive, or no effect on student achievement in these different studies.

More recently, charter school effectiveness studies nationally or across multiple states are also inclusive (CREDO, 2009; Lubienski & Lubienski, 2006). Both the national and multi-state studies provide a representative picture of charter schools, although they are generally limited by

their study design. For instance, national tests such as the National Assessment of Educational Progress (NAEP) provide a cross-sectional assessment that precludes value-added modeling, which is generally regarded as a stronger measure of school effectiveness than the measures relying only on levels of achievement data (Betts, Tang, & Zau, 2007). Moreover, to date, longitudinal student achievement data used in national studies are usually compiled from the particular achievement test used in different states. These tests often do not assess comparable skills and are based on dissimilar scales. Consequently, studies using these assessments do not provide a valid and consistent measure of student achievement for all students across the nation (Betts et al., 2006, Miron & Applegate, 2009). On the other hand, state-specific studies, such as this one, can use consistent measures of student achievement over a number of years. In addition, national studies and state comparative studies also may be hindered because charter school laws vary widely on mission, finance, regulation, and support from state to state. It is reasonable to expect different policies and implementation to influence charter school outcome substantially. The evidence of state-specific studies is important to more fully understand the variations of charter school effectiveness in different policy environments. However, only a few states to date provide comprehensive longitudinal student level data for rigorous state-wide studies.

Based on multiple years of student-level data from 2004 to 2009, this paper utilizes two alternative methodologies to evaluate the Utah charter school effectiveness. Despite the overwhelming support of charter schools among politicians and increasing interest by parents, the information on Utah charter school effectiveness remains largely based on anecdotal evidence. This study presents a timely and interesting case. First, it has great policy implications. While we do not argue that charter schools are not a viable school alternative in

Utah, we do provide evidence relative to whether charter schools are a better alternative based on the assumption of increased student performance to the TPS system in the state. Second, the charter school movement in the United States continues to grow at a rapid pace while evidence is not conclusive. Researchers argue that the effectiveness of charter schools depends on many factors, including different features of charter school policy as well as the local contexts in which the policies are implemented (Levin, 2002). As a state with reportedly friendly charter school policies and the lowest per pupil funding, Utah presents a unique case.[1] Also, in comparison to charter schools in many other states and locales, Utah charter schools serve a significantly more advantaged, and predominately white, student population. In that sense, this study extends existing literature and makes a potential contribution to generalizing the effects on charter schools as a whole.

2. LITERATURE REVIEW

Because much has been reported elsewhere regarding the general effects of charter schools, here we turn our focus to the methodological issues that both help and hinder our understanding of charter schools to date. Estimating the effects of charter schools is methodological challenging. The most serious problem arises because charter school students are self-selected and may vary systematically from those who remain in TPSs (Betts et al., 2006). For example, parents' choice to enroll their child in charter schools is based on factors such as parental preference, motivation, and their involvement in their child's education, which are

[1] Frequently when discussing education in Utah, questions arise with regard to the influence of religion in education in the state. Although an important question, this was not the focus of this inquiry. Importantly, we must also note that we only utilized official records maintained by the Utah State Office of Education (USOE), which does not contain any religious-related data. That said, it is also important to note the USOE charter school site explicitly addresses whether or not the charter schools in the state can have a religious affiliation:

> "They must function like every other public school in Utah. They must meet all of the same standards and comply with all of the same laws. A charter school program cannot be affiliated with or restricted to a particular religion. Curriculum, admission policies and employment practices must all be nonsectarian." (USOE, Charter Schools, http://www.schools.utah.gov/charterschools/Frequently-Asked-Questions.aspx)

usually unobserved. Ideally, the influence of these factors on student achievement needs to be controlled when estimating how the attendance of charter schools has influenced student achievement.

Several empirical strategies have emerged in the research to eliminate the self-selection bias. The first approach, generally regarded as the best approach in eliminating the bias, is through the random assignments of students in charter schools and TPSs. Hoxby and Rockoff (2004) compared achievement for students who were accepted or denied through a lottery process to oversubscribed charter schools in Chicago. In their study, they found that charter schools have a positive effect on students, especially those in early grades. Applying the same method, Hoxby and Murarka (2007) evaluated New York City charter schools and also found positive charter school effects. In addition, a study of Boston's charter schools also found large and significant differences in test scores for charter lottery winners in the middle and higher school (Abdulkadiroglu et al., 2009). However, this experimental method is often not feasible, particularly when charter schools are not sufficiently oversubscribed, when admissions are not based on random selection, or when the information on students who did not get selected is not available. Even when lotteries are used, the results of lottery-based studies can only be generalized to a limited set of schools who are popular enough to have long waiting lists.

The second approach to reduce the self-selection problem is to create a matched sample of TPS comparison students that are as similar as possible to charter school students, and then statistically compare the achievement gains between the matched charter and TPS students. The matching can be done through a Virtual Control Record (VCR) approach or propensity score matching (PSM). In a study of charter school performance in 16 states, CREDO (2009) used the VCR technique that each charter school student is matched to a student enrolling in a TPS that

have students who transferred to charter schools. The match factors include multiple demographic variables and prior test scores. That way the VCR method produced pairs of students that have mirror images except that one is schooled in a charter school and the other in a TPS. Based on the matched sample, the authors found that on average charter school students perform lower than their TPS peers. The studies using similar matching designs have been frequently used in charter school studies to control for selection bias (Miron et al., 2007; Solmon, Paark, & Garcia, 2001).

PSM is slightly different from the VCR method. In the PSM model, charter school students are matched with TPS students based on the similarity of a predicted probability of attending charter schools, which is based on observed predictors usually obtained from logistic regressions. This method has been used by scholars to examine how school operational features and instructional conditions in charter schools influence students' achievement gains (Berends et al., 2010; Zimmer et al., 2003; Zimmer & Buddin, 2007). Both the VCR and PSM techniques can reduce greatly the self-selection bias, if the decision whether to enter a charter or a TPS of a given student is based on observed variables. However, it is possible that matching will not totally purge the selection bias, if some unobservable variables, such as motivation or parental involvement in education, determine whether a student decides to enroll in a charter school (Rosenbaum & Rubin, 1983).

The third approach to mitigate the impact of the self-selection bias is through the student fixed-effects models. Based on longitudinal student-level data that provide repeated observations of student achievement across school sectors, test score gains of students in charter schools are compared to the test score gains made by the same students while they were in TPSs, either before or after they were in a charter school. Since students are compared to themselves,

the selection bias is effectively controlled. Any unobserved student characteristics related to both the likelihood to attend a charter school and achievement can be removed by the fixed-effects transformation, if these unobserved characteristics do not change over time.

With the increasing availability of longitudinal student level data, researchers have used the third approach to study charter school achievement. For instance, there have been two studies in Texas (Booker et al., 2007; Hanushek et al., 2007), one study in North Carolina (Bifulco & Ladd, 2006), one study in Florida (Sass, 2006) and one study in Idaho (Ballou, Teasley, & Zeidner, 2008). In addition, other studies focus on major districts or cities (Betts et al., 2007; Imberman, 2007; Nicotera, Mendiburo, & Berends, 2011). All these studies rely on large state-specific or district-specific longitudinal student level data with student-fixed effects removed to control for time invariant unobserved student characteristics. Some of the studies further refine their analysis by comparing charter schools by several features including operating years, the types of students they serve, their pre-existing status, and their organization.

Although these studies have not reached a consensus about the impact of charter schools on student achievement, some patterns in the main results have emerged. Most of the studies found that charter school students make smaller achievement gains than they would have in TPSs initially, although an overall underperformance of charter schools diminishes the longer the charter schools are in operation. However, while some studies found that the negative effects of charter schools disappear after three to five years of operation for new charter schools (Booker, et al., 2007; Hanushek et al, 2007; Sass, 2006), others found that the achievement gap between TPS students and charter school students remains statistically significant and large even after five years (Bifulco & Ladd, 2006). In addition, most fixed-effects studies found that student mobility, as expected, is very disruptive in student learning. In North Carolina, for instance,

Bifulco and Ladd (2006) illustrated that a large proportion of charter school underperformance can be explained by the disruptive effects caused by their high student turnover rates, which are much higher compared to TPSs. An exception to this finding is Ballou, Teasley, and Zeidner's (2008) study of Idaho charter schools where the charter schools are more effective than TPSs and newer charter schools are more effective than schools that have been in operation longer. Ballou et al. explained this exception might, in part, reflect changes in the mix of students recruited to a school over time.

Other features of charter schools also have an impact on student achievement. For example, charter schools that predominately serve at-risk students perform worse than charter schools serving a generally more diverse population (Sass, 2006). On the other hand, although rigorous large-scaled studies typically find small positive effects in elementary and middle charter schools, charter high schools tend to underperform significantly in math (Betts & Tang, 2008).

Although student fixed-effects models are effective in reducing student self-selection bias, there are several potential weaknesses of the method. First, it can only eliminate unobserved differences between charter and TPS students that remain constant over time. If parental input on student learning varies over time and systematically responds to student performance level, these differences could not be controlled in the fixed-effects model and the estimates will be biased. Second, all time-invariant variables such as students' gender and ethnicity are included in the term of the individual student fixed-effects and cannot be estimated. Finally, fixed-effects models rely only on "switchers"—students who have both attended charter schools and TPSs—by comparing achievement gains before and after they switched between charters and TPSs. If the switchers cannot represent all charter school students, then both the

internal and external validity of the results will be significantly reduced. Indeed, this is likely the case in Utah, where more than one-third of students who enrolled in charter schools have never entered a TPS during their educational process.[2] It is possible that the "switchers" might have characteristics that are distinct from the students who never entered a TPS. By comparison, the matching approach can include all charter school students in the estimation, including those who have never switched back and forth between charter schools and TPSs.

In this section, we have both identified the findings from charter school studies as well as the advantages and limitations to the different methods that have been used to date. Thus far, most of the sophisticated quantitative charter school studies have relied on only one method, either the lottery-based method, the matching method, or the student fixed-effects models, which all suffer from different potential biases. In addition, despite the size and importance of the charter school movement, quantitative analysis of the impact of charter school attendance on student achievement are only available in a very few states and major cities with mixed evidence. Consequently, studying charter schools in select settings using multiple methods to purge the confounding effects of self-selection in choice participation, such as this study, is imperative. Specifically, in this study we utilize both the matching and student fixed-effects approaches to estimate the effectiveness of Utah charter schools.

3. THE UTAH CHARTER SCHOOL PROGRAM

Among all the 40 states with charter school laws, the Utah charter law structure was ranked as the 4th strongest or most charter-friendly by the Center for Education Reform in 2010

[2] During 2004-2009, among all students who have attended any charter school for at least one year, about 43% never attended in TPSs. Half of these students, however, just started kindergarten or first grade in school year 2008-2009, as nine new charter schools opened that year. With the fast growth of charter schools, we expect to see more students start schooling in charter schools and remain in the charter school sector.

yet 11th in 2011.[3] Utah officially established charter schools in 1998. Admittedly, the State Charter School Board in Utah does not emphasize nor establish the expectation that state charter schools will outperform their peer traditional public schools, although the State Charter School Board does maintain expectations for academic goals and continued performance growth in the charter schools. Despite the rhetoric regarding expectations for charter schools, the Utah State Office of Education (USOE) Charter School Division describes the purpose of charter schools as:

> Charters schools offer parents and students additional choices about where students attend school and the school's curricular emphasis. They allow educators freedom to try new strategies to inspire students and to experiment with innovative ways of educating students. Also, charter schools allow individuals and organizations outside of the traditional education system to create and run public schools. [4]

The growth of the number of charter schools and the charter school enrollment in Utah has been steady. Charter schools in the state had 390 students in the first year of operation compared to about 33,000 ten years later in 2008-2009, which accounts for about 5% of all public school students in Utah. In 2008-2009, there were 65 operational charter schools.[5] Reportedly, many charter schools have waiting lists. Currently, there are no caps on the number of charter schools. Following the 2010 Legislative Session, the State Board of Education also was given the authority to remove the cap on charter school enrollment contingent on the availability of legislative appropriations (see Utah Code §53A-1a-502.5).

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[3] Please see http://www.edreform.com/_upload/ranking_chart.pdf and http://www.edreform.com/download/CER-Charter-Laws-2010.pdf. The Center for Education Reform based their ranking on multiple factors, such as the existence of caps on the number of charter schools or enrollment, funding, start-up assistance, and the amount of regulation over charter school operations.

[4] Please see http://www.schools.utah.gov/charterschools/Frequently-Asked-Questions.aspx

[5] Fourteen new charter schools have opened up between 2009-2010 and 2010-2011.

Statewide, charter schools enroll significantly lower percentages of student of color and students from low-income families, as indicated in our analysis later. According to provisions of the Utah Code §53A-1a-506, Utah charter schools, as a public school choice option, must maintain an open enrollment similar to their traditional public school peers. Charter schools have a higher proportion of elementary students and a lower proportion of high school students than TPSs. It is anticipated that this will lead to further demand for charter school availability as a student progresses from the elementary to secondary school level. It is important to note that charter school enrollment is open based on available enrollment space. When enrollment space is exceeded by demand, the charter school is required to use "random" selection.

Utah charter schools are governed locally by their charter school board. Both the Utah State Board of Education and the State Charter School Board have authority over the charter schools. They may be authorized by local school boards, the Utah State Charter School Board with recommendation to the State School Board, and—as of 2010—higher education institutions. The majority of the charter schools are chartered by the State Board. According to Utah Administrative Code (R277-470-6), charter schools now must be approved two years prior to opening their doors to students. Moreover, charter school applicants are required to attend an orientation and training session (Utah Administrative Code R277-470-4) provided by the State Charter School Board. Participation in the training may result in priority status for approval as well as additional funds. The training topics include, but are not limited to, implementation, statutory, and Charter Board, financial, data management, legal, and funding requirements. There are five identified contingencies for revoking a charter, including issues of charter quality, finance, student achievement, compliance, and adherence to their proposed

charter (Utah Administrative Code R277-470-12). Up until 2009, only one charter school in Utah closed as a result of management deficiencies.

Utah charter schools receive revenue from state funds (e.g., Local Revenue Replacement Program, Minimum School Fund, Revolving Loan Fund for capital outlay, School LAND Trust funds), federal funds (e.g., Federal Dissemination grants, Federal Start Up and Implementation Awards), and other sources (e.g., grants, endowments, gifts, property donations). The local replacement program and revolving loan fund are specifically intended to reduce the disparity in revenue generating capacity between charter schools and TPSs, similar to the purpose of the federal funding sources for charter schools. Current state fiscal policies require districts to contribute a portion of the local property tax revenue they raise to the local replacement program according to the number of charter students residing within their boundaries. Charter schools in Utah are not eligible for state-supported transportation funding.

4. DATA

The USOE Data Warehouse since 2003-2004 is complete with a record of all students' history in Utah public schools, including their residence, enrollment, attendance, demographic data for each year, and records of any standardized test taken starting in the 1st grade through 12th grade. Students can be tracked over the years through a unique identifier as long as they remain in the Utah public school system, both TPSs and charter schools. In addition, the USOE provides detailed information on every public school in Utah, including charter schools. The information includes but is not limited to the school type, location, grade span, opening and closing years. Virtual schools are omitted from our analysis. Also omitted are those schools that exclusively serve children with special needs as well as those that serve disciplinary facilities.

The student achievement data are based on performance on state sponsored criterion referenced test (CRT) performance, providing information about the core skills and abilities students have acquired during the school year or course. The scores are reported on the same scale for all tests in math, language arts, and science. They provide comparable information on student performance for different years and different tests. The language arts and math CRT tests are administered in grades 2 to 11.[6] Language arts tests are grade-specific, where students take the test that corresponds to the grade in which they are enrolled. The tests for mathematics for grades 1-6 and grades 7-11 are different, however. Math tests are grade specific in grades 1-6 and course specific in grade 7-11. Starting from grade seven, students take a sequence of math courses such as pre-algebra, algebra, and geometry in different grades based on their prior performance and teacher recommendations. As a result, students in the same grade can take CRT tests for different courses. This makes comparing math achievement growth in grades 7-11 impossible for grade-level comparisons. Consequently, in this study, we only use elementary math scores in grades one to six, which are consistent in core curriculum. In addition, math CRT scores in 2009 were excluded in the analysis because the test changed in both test contents and scales, resulting in a different test that makes it inaccurate and inappropriate to compare the 2009 math scores to years prior to that time. For easier interpretation, all the scale scores are converted to standard scores with a mean of zero and standard deviation of one, specific to grade, subject, and year.

Different from many other states, Utah charter schools tend to serve more racially and socially advantaged students than TPSs. According to Table 1, charter schools have lower percentages of Hispanic students, low-income students, special education students, and English

[6] Due to legislative changes, the CRTs are no longer administered in Grade one since 2008.

language learners than TPSs. For example, although the average percentage of White students in TPSs dropped from 82.8% in 2004 to 78.1% in 2009 due to the demographic shift in the state, the average percentage of White students in charter schools remains high, consisting of 83.2% of all charter enrollment in 2009. Although charter schools now serve higher percentages of low-income and English language learners than in 2004, the proportions of these students remain significantly lower than TPS schools. Table 1 also shows that charter school students have slightly higher levels of performances on the state's language arts and math CRT tests. However, it would be premature to conclude that charter schools are more effective since student test scores are highly correlated with student demographic characteristics.

[Table 1 about here]

5. METHODS

Two different approaches are used to estimate the influence of charter school attendance on student achievement in Utah. Both approaches rely on longitudinal student-level data from 2004 to 2009 and value-added models to follow individual students over time as well as to examine their achievement gains. The first approach utilizes hierarchical linear modeling (HLM) to compare students' achievement growth in charter schools and TPSs. As noted, the advantage of this method, compared to the fixed-effect models, is that we can include all students who attended charter schools for at least one year during 2004 and 2009 in our analysis. Comparing charter school students with TPS students, however, suffers from self-selection problems because students in the two types of schools might be systemically different from each other. In order to mitigate the self-selection bias, we first use the matching techniques to create a comparison group of charter and TPS students that are as similar as possible to each other based on multiple variables.

Our second method utilizes student-fixed effects regressions that compare the achievement gains of the same students in charter schools and TPSs. This method controls for selection bias because students are compared to themselves when they switch between charter schools and TPSs. The main disadvantage of the method, however, is that it focuses only on students who switch in and out of charter schools and ignore students who always attended charter schools and never entered the TPS system.

In both methods, we control for two confounding factors that have been found in the literature to influence student performance. First, literature has shown that charter school performance generally improves when they gain more experience. Traditional public schools, on the other hand, do not seem to experience the same performance growth, in part because of the presence of necessary support and resources when new TPSs are open (Sass, 2007). To capture the possible vintage effect of charter schools, we categorize charter schools by their operational years through a series of dichotomous variables. Among the 65 charter schools in our dataset, 30 schools have no more than 3 years of experience, 9 schools were in their 4^{th} year of operation, 11 in their 5^{th} year, and the remaining 15 schools have been opened for 6 or more years.

Second, research has shown that student mobility is usually disruptive in student learning because of factors such as differences in curriculum pace and disruption of learning due to transfer to a new school facility, unfamiliarity with teachers and administrators, new classmates, and different expectations for student conduct and so on (Lash & Kirkpatrick, 1990; Lash & Kirkpatrick, 1994). In addition, transfers between charter schools and TPSs might have very different effects on student achievement from the transfers within each sector, because of the institutional and organization differences between the two types of schools. As shown in Table 2, Utah charter schools have lower student turnover rates than TPSs, unlike the case in some

other states (Bifulco & Ladd, 2006; Booker et al., 2007). However, charter school students are much more likely to transfer back to a TPS than to another charter school, which might reflect the fact that there are not many charter schools close by to choose from. TPS students, on the other hand, also tend to transfer between TPSs instead of moving to a charter school. Utah maintains various open enrollment opportunities, through which students are free to transfer to another TPS either within or outside the district boundary provided the receiving school has space. Table 2 also shows that charter schools have higher percentages of students exiting the Utah public school system than TPSs. That is, these students do not appear in the Data Warehouse records due to reasons such as moving out of the state, dropping out of school, attending a private school, or being home schooled.

[Table 2 about here]

Following the literature, we also classify student mobility into two broad categories: structural move and non-structural move. Structural move is defined as a student in the highest grade offered, or terminal grade, in a school and moves into a new school the following year. Structural moves are common as students move from elementary to junior high to high school. Non-structural move means students who are not in a terminal grade change their schools from year to year. This includes, for instance, family relocation, inter-district choice, intra-district choice, or transfer between charter and TPSs. As research has shown, structural moves tend to have a larger disruption effect than non-structural move, perhaps due to very different curriculums and expectations (Booker et al, 2007).

As Table 3 shows, while charter schools have higher non-structural mobility than TPSs, their average structural mobility is only one-third of that of TPSs. A closer examination of mobility by grade level reveals that TPSs have higher structural mobility rates in certain grades

because of Utah TPSs grade span configurations. The highest structural mobility occurs in the elementary to middle school transition (grade 6 to 7 or grade 5 to 6) and middle school to high school transition (grade 9 to grade 10 or grade 8 to 9). On the other hand, charter schools have more varied grade level combinations such as k-8, k-9, 7-12, or k-12. So their transition patterns across grades are very different from TPSs.

[Table 3 about here]

To gauge the student mobility effect as part of the charter school effectiveness, we include a set of measures to indicate whether the student transfer is a move between TPSs, between charter schools, from a charter school to TPS, from a TPS to a charter school, and whether the transfer is a structural move. In addition to the charter school vintage effect and the student mobility effect, we also control for various family and school characteristics that also influence student achievement, which we elaborate later. Since the HLM models with matched samples and the student fixed-effect models are susceptible to different potential biases, we compare the results from both methods as a robustness check. We now turn to introduce both methods in more details.

HLM with matched samples of charter school and TPS students

Although there are 41 school districts in Utah, charter schools attract the majority of their students from only several districts largely along the Wasatch Front. In 2008-2009, about 75% of all charter school students were residents of six school districts: Alpine, Jordan, Nebo, Davis, Granite, and Salt Lake City. If we compare student achievement in charter schools in Salt Lake City with TPS students in the North Summit district, a rural district hosting no charter schools and with no resident students attending a charter school, we are at the risk of comparing apples to oranges. In addition, students in charters and TPSs are systemically different, which partially

accounts for the difference in achievement levels and growths between charter and TPS students. In order to make a more accurate estimation of charter school effects, we first created a comparable group of charter and TPS students through a revised VCR approach that was used by CREDO (2009). Then, based on the matched sample, we used two-level HLM growth models to analyze how charter school attendance influences the trajectories of student achievement growth (Raudenbush & Bryk, 2002).

Matching

To create a reliable comparison group for charter school students, we aimed to match each student who had attended a charter school at least once during the 2004 and 2009 time period with a TPS student who has never attended a charter school during the same period of time, and was identical or most similar to the charter school student on multiple variables, including their prior student achievement. This is done through several steps. We first identified all students attending a charter school in 2005 and tracked each of them back to 2004 and identified his or her resident zip code. All TPS students residing in the same zip code in 2004 became potential matches for this particular charter school student.[7] Then we limited the pool of potential matches based on several factors so that the TPS students have exactly the same characteristics as the charter school student on grade-level, gender, race/ethnicity, free or reduced price lunch status, English language learner status, and special education status. This step greatly reduced the number of potential matches for each charter school student. Then, among all TPS students remaining in the matching pool we identified the one whose

[7] In CREDO's report (2009), the authors identified potential matches of charter school students as all students in their "feeder schools," or the TPSs that have students transferring to a given charter school. This method will not be appropriate here, because a substantial portion of Utah charter school students have never entered a TPS. For these students, they do not have a TPS as their feeder school.

achievement in 2004 was the closest to that of the charter school student.[8] This procedure produced a matched sample of TPS students for all students who attended a charter school in 2005. Once matched up with a charter student, the TPS student was removed from the potential pool so that she or he would no longer be matched to another charter school student.

Next, we moved on to the year 2006 to identify all students who first appeared in charter schools. We then tracked them back to 2005 and repeated the steps above to match them with TPS students according to their demographic characteristic and prior achievement in 2005. We repeated the same procedure for all the following years up to 2009 until each charter school student was matched with a TPS student who has exactly the same demographics and the most similar baseline performance. Finally, based on the unique student identifier, we extracted all the information for each student in the matched sample from 2004-2009, or all the years that the students were in the Utah schooling system, for the subsequent HLM growth model analysis. The matching greatly reduced the selection bias because of the observable similarities between these charter school students and TPS students.[9] Further, since the matched pairs are from the same resident zip code, it helps to mitigate a significant portion of selection bias since families residing in the same areas tend to be similar in unobserved ways and also should have similar knowledge about the availability of charter schools in the neighborhood.

HLM growth models with matched sample

Based on the matched sample of charter and TPS students, we estimated a series of two-levels of HLM growth models that compare student achievement gains to test whether charter

[8] Students in grades one to six are matched based on scores of both math and language arts. Students in seventh grade and above are only matched based on language arts scores. Grade one students don't have prior scores, so they are matched when they get to grade two.

[9] However, there is a trade-off of the matching approach against a small reduction in the sample size. Since students are matched based on information the year prior to their first appearance in charter schools, students who only enrolled in a charter school in the first year that she or he appeared in the dataset and then moved to a TPS in all subsequent years during 2004 and 2009 could not be matched.

school attendance produced better or worse achievement gains for students than they would have obtained in TPSs.

Level 1:

$$Y_{ti} = \pi_{0i} + \pi_{1i}\,(\text{grade})_{ti} + \pi_{2i}(\text{charter})_{ti} + \pi_{3i}(\text{other time-varying variables})_i + e_{it}$$

Level 2:

$$\pi_{0i} = \beta_{00} + \beta_{01}(\text{student characteristic})_i + r_{0i}$$

$$\pi_{1i} = \beta_{10} + \beta_{11}(\text{student characteristic})_i + r_{1i}$$

$$\pi_{2i} = \beta_{20} + \beta_{21}(\text{student characteristic})_i + r_{2i}$$

$$\pi_{3i} = \beta_{30} + r_{3i}$$

The level-1 model is a within-student repeated-observations model, where student i's achievement of math and language arts at time t, measured as Y_{ti}, is represented by an individual linear growth trajectory. Grade_{ti} is the grade at time t for student i, and π_{1i} is the growth rate of student achievement as they progress through grades. The variable of interest is the time-varying dichotomous variable, charter_{ti}, indicating whether student i attended a charter school in year t. The coefficient π_{2i} represents the effect of charter school attendance of a student in a particular year, or the deflection from the expected achievement growth. Charter schools are further categorized by years in operation, which capture the possible vintage effect. Other control time-varying variables at level-1 include the eligibility of free/reduced lunch program (FRL), student mobility, and programmatic characteristics such as enrollment in special education or English Language programs. All of these variables might change over time for a particular student. In addition, student achievement growth varies across individuals, depending on their family backgrounds, school input, and peer environments. Since students tend to transfer between schools from year to year, school characteristics are time-variant as well. We include a full set

of student composition of the school a student attended in a particular year to control for the learning environments of students.[10] The level-1 model also includes a set of grade dummies and year dummies to control for the test fluctuations pertaining to grade and year.

The unit of the level-2 model is student. All the time-invariant student characteristics that affect student achievement and growth, such as race/ethnicity and gender, are included in the level 2 models to predict their mean achievement, the rate of achievement growth, and the differential effects of charter schools on their achievement.

Value-added student fixed-effects models

In our second approach of estimating the effectiveness of charter schools, we rely on repeated observations on individual students to control for individual fixed effects, and compare the test score gains of students in charter schools to the test score gains of the same students when they attend TPSs. This method can effectively control for the self-selection bias since each student becomes his or her own comparison group.

Typically, researchers follow a general cumulative model of student learning, where student achievement is a function of entire input histories of family inputs, school inputs including their attendance in charter schools, and students' innate ability. The model allows the effects of inputs from previous years on current student achievement to diminish at an annual depreciation rate of $1-\theta$. Although the value of θ is unknown, it is between 0 and 1.[11] The general model for the achievement of student i in grade G in year T can be expressed as equation (1) (Bifulco & Ladd, 2006; Hanushek et al., 2007; Sass, 2006):

[10] Since we explicitly model student transfer between schools across the years, it is not possible to use a 3-level HLM where individual students are nested within schools. In addition, cross-classification models between students and schools are not feasible because school characteristics, including student composition, change over time.
[11] This means, the school input in a student's fourth grade has a smaller effect on her fifth grade achievement than on her fourth grade achievement and an even lesser effect on her seventh grade achievement.

$$Y_{iGT} = \alpha \sum_{t=1}^{T} \theta^{T-t} CH_{igt} + \beta \sum_{t=1}^{T} \theta^{T-t} \mathbf{X}_{igt} + \delta \sum_{t=1}^{T} \theta^{T-t} \mathbf{S}_{igt} + \sum_{g=1}^{G} \theta^{G-g} \gamma_{ig} + \varphi_{GT} + v_{iGT} \quad (1)$$

where CH_{igt} is a dichotomous variable indicating whether student i for grade g attends a charter school in year t. The summation of the term from time period 1 to the current time period T indicates that the effect of charter school attendance on current achievement accumulates over time, with the attendance in the past having a weaker influence (θ^{T-t}) than the attendance in the current year. Similarly, $\mathbf{X}_{igt}$ is a vector of time-varying student characteristics including student mobility that have cumulative effects on student achievement. The sum of $\mathbf{S}_{igt}$ are the quality of schooling including school input and peer composition from all previous years. The term γ is student systematic characteristics such as parental care and early family input, innate ability, and other unobserved factors. It remains constant over the current school year and accumulates over time at the same depreciation rate of 1 - θ as other inputs. In addition, φ_{GT} is a grade-by-year fixed effect that captures fluctuations in test performance across grades and cohorts that may introduce spurious correlation between charter school composition and achievement. v_{iGT} is the idiosyncratic error term that changes across time for each student.

To simplify equation (1), we rewrite the equation for $Y_{i(G-1)(T-1)}$, achievement of student i in grade G-1 and year T- 1. We then take the difference between equation (1) for Y_{iGT} and for $\theta Y_{i(G-1)(T-1)}$ and get equation (2):

$$Y_{iGT} - \theta Y_{i(G-1)(T-1)} = \alpha CH_{iGT} + \beta \boldsymbol{X}_{iGT} + \delta \mathbf{S}_{iGT} + \gamma_{iG} + \tau_{GT} + \varepsilon_{iGT} \quad (2)$$

$$where \;\; \tau_{GT} = \varphi_{GT} - \theta \varphi_{(G-1)(T-1)},\; \varepsilon_{iGT} = v_{iGT} - v_{i(G-1)(T-1)}.$$

Equation (2) potentially controls all historical factors that influence student achievement. It is also much easier than equation (1) to be empirically estimated. If we restrict the value of θ to 1, which assumes that the impact of past input on current performance does not fade over time, the

gain of achievement is now a function of any charter school participation in the current year, current school and student input, an individual-specific fixed effect, and a grade-by-year fixed effect, which can be estimated through fixed-effect models that remove the student fixed effect term γ_{iG}. Although this restricted value-added model is not really realistic, researchers have used this form in charter school studies as well as in other literature.

If we pose no restriction on θ' value, we can rearrange equation (2) by adding $\theta Y_{i(G-1)(T-1)}$ to both sides, so that $Y_{i(G-1)(T-1)}$ becomes an explanatory variable with parameter θ. Now the new equation can be interpreted as a non-restricted value-added specification, where the current achievement level depends on lagged achievement that depreciated at a certain rate. Now that the equation includes the lagged dependent variable, the usual fixed-effect estimations will be biased due to autocorrelation and the correlation of the lagged variable and the error term. To solve this problem, the General Methods of Moments (GMM) with instrumental variables can be applied, where the student fixed effect, γ_{iG}, can be removed by first-differencing the data:

$$\Delta Y_{iGT} = \theta \Delta Y_{i(G-1)(T-1)} + \alpha \Delta CH_{iGT} + \beta \Delta \boldsymbol{X}_{iGT} + \delta \Delta \mathbf{S}_{iGT} + \Delta \tau_{GT} + \Delta \varepsilon_{iGT} \qquad (3)$$

After first differencing, $\Delta Y_{i(G-1)(T-1)}$ is necessarily correlated with the error term $\Delta \varepsilon_{iGT}$ because $Y_{i(G-1)(T-1)}$ and $\varepsilon_{i(G-1)(T-1)}$ are correlated. To circumvent this problem, we follow the Arellano–Bond dynamic panel GMM estimator using the second and deeper lags of student achievement as instrumental variables for $\Delta Y_{i(G-1)(T-1)}$ (Sass, 2006; Wooldridge, 2002). The idea is that two or more lags of Y are correlated with the lagged achievement, $\Delta Y_{i(G-1)(T-1)}$, but are uncorrelated with the error term $\Delta \varepsilon_{iGT}$. Note that since the data are first differenced and in need of the second lag as the instrumental variable, only students with three consecutive years of data are included in the models.

6. THE EFFECT OF CHARTER SCHOOLS ON STUDENT ACHIEVEMENT

HLM Growth Models Results

The VCR matching procedures resulted in a comparison sample of 20,215 students who were observed at least once in a charter school during 2004-2009 and their TPS counterparts who had never entered a charter school in the same period of time. The sample represents about 97% of all charter school students who have achievement data.[12] Table 4 presents the baseline information of the matched sample the year before a charter school student was matched. The pairs have exactly the same demographic characteristics. The starting math and language arts test scores are very close and all the differences between the two groups are not statistically significant.

[Table 4 about here]

A series of two-level linear growth models were then performed based on the matched samples of charter and TPS students. The results from the unconditional models with no controls at either level, though not reported here, show that the proportion of the variance of achievement at level 2 is around 66% to 68%, depending on the subject, indicating substantial variation in average achievement levels among individual students.

Table 5 shows the estimate results of the conditional models with the full set of student and school control variables at both level 1 and level 2. The same analysis is repeated for elementary math, elementary language arts, and secondary language arts. As indicated earlier, secondary math is not estimated because the tests are course-based, and the scores are not comparable across grades. For each subject, three models are estimated. The differences between the three specifications are the measures of charter school attendance and mobility. For instance, Model 1 uses a dichotomous variable indicating students' charter school attendance in a

[12] The remaining 3% were not matched either because they do not have a close match in TPSs based on one or more variables, or they only appeared in a charter school in the first year that they appeared in the dataset during 2004 and 2009, and so that they do not have prior student achievement to be matched.

particular grade and the student mobility is described through two variables, move and structural move. Model 2 further distinguishes the operational years of charter schools through a set of dichotomous variables, while Model 3 further categorizes student mobility into moves within and between the charter school and TPS sectors.

[Table 5 about here]

As the results of Column 1 in Table 5 indicate, students who attend charter schools have lower math test score gains by .04 standard deviations in elementary schools. The negative effect is primarily driven by newly established charter schools, as indicated by the results in Column 2. On average, students attending charter schools within their first year of operation experience about .12 standard deviations smaller gains in math than the students attending TPSs. The magnitude of the negative results decreased for charter schools after two years of operation. Starting from the third operational year, the trend is reversed. Students enrolling in charter schools with three to five years of experience obtained greater math gains than students attending TPSs. This confirms the findings from other studies that charter schools do learn from their experience. After experiencing significant start-up difficulties, their performances improve once they are more established. However, in their sixth year of operation and beyond, charter schools make no different gains from TPSs in math, a result that is less consistent with those from other models.

Student mobility has a negative effect on elementary math achievement. On average, a student transfer is associated with 0.04 to 0.06 standard deviation decrease in their math test score gains, as indicated in Columns 1 and 2 of Table 5. The structural movement has an extra disruptive effect round 0.11 standard deviations on math score gains. When we further categorize student mobility as charter to TPS moves, charter to charter moves, TPS to TPS

moves, and TPS to charter moves, we find different types of mobility has different effects on student achievement, as shown in Column 3 of Table 5. As expected, both moves from TPSs to charters and between TPSs have negative effects on student achievement. While transferring from one charter school to another seems to have no significant impact on student achievement, the transitions from charters to TPSs actually have a positive effect on student achievement. Although this seems to be odd at first sight, it is consistent with the findings in previous studies (booker et al, 2008). Given the scope of this study, however, we cannot attribute an underlying reason for this.

After controlling for the different types of student transfers, the charter school effect on elementary math become less negative in their earlier years and more positive when they are more established. For example, the estimated negative effect of first-year charter schools on elementary math becomes smaller, changing from -.12 standard deviations in Column 2 of Table 5 to -.09 standard deviations in Column 3, and the magnitudes of the positive effects of more established charter schools increased. Note that the total effect of charter schools is a combination of the effects of charter attendance and student mobility. Although charter schools in Utah have lower mobility rates than TPSs, student mobility seems to have a more disruptive effect for students in charter schools than those in TPSs. The reason for this effect is not certain based on this study. However, this may indicate that charter schools have fewer structures in place (e.g., student transition plans) than TPSs to make newly transferred-in students better acclimated with their school and learning environment.

Columns 4-6 of Table 5 present the estimates of the impact of charter schools on elementary language arts achievement gains. Similar to the results of the math models, charter attendance on average has a negative effect on language arts test scores gains. The effect of

attending a charter school that has opened no more than four years remains negative, although the magnitude of the negative effect decreases over time. Only as charter schools reached their fifth year of operation did they perform as well as TPSs. The effects of student mobility on language arts performance are very similar to its effects on math scores, but to a lesser extent.

The charter school effect on secondary language arts is somewhat different. As shown in Columns 7-9 of Table 5, secondary charter schools in general perform as well as secondary TPSs. Thus, they do not exhibit the same start-up difficulties as elementary charter schools. Only in their first year of operation do charter schools have a negative effect on students' secondary language arts performance, which lessens after controlling for student mobility. In their second to fourth year of operation, their students perform at the same levels as TPS students. Starting from the fifth year of operation they actually perform .03 to .06 standard deviations better than TPSs.

Student learning growth rates in different subjects is also reported. After controlling for the fluctuation of tests by year and by grade, students show slightly positive growth rates in achievement in elementary math, no significant change in elementary language arts, and slightly negative slope in language arts in secondary schools. Since the CRT tests are not designed to be vertically aligned, this does not mean that students experience negative growth in secondary school, but instead implies a slightly slower growth rate than in elementary schools. Nonlinear learning growth curve is not further explored here since it is not the focus of the paper.

Table 5 also reports the effect of time-varying student characteristics on student achievement. As reported elsewhere, low-income students, special education students, and ELL students all experience lower achievement growth in charter schools. In addition to the results reported in Table 5, all specifications also include time-varying school characteristics in the level

1 model and time-invariant student characteristics in the intercept, the growth rate slope, and the charter slope at level 2. These results are not reported in the table due to space constraints.

Fixed effects regressions and GMM results

Table 6-8 present our estimates of the effects of charter schools on student achievement in elementary math, elementary language arts, and secondary language arts, respectively. In each table, the charter school effect is estimated through two different methods. In the restricted value-added fixed-effects models, the dependent variable is the gain score, or the change in student achievement from one year to the next, while in the non-restricted value-added dynamic panel GMM estimators, the lagged dependent variable is included as a control variable.

[Table 6 about here]

[Table 7 about here]

[Table 8 about here]

As shown in Table 6, charter school attendance has a negative but insignificant effect on elementary math gains in the fixed-effects models. However, the GMM results indicate that math achievement in the average elementary charter school is .05 standard deviations lower than the average elementary TPS, as indicated in Table 6. The GMM result is very similar to that of the HLM math model, which has the coefficient of -.041 (as shown in Column 1 of Table 5). In addition, consistent with the HLM results, the negative effect of charter schools is primarily driven by newly established charter schools, as indicated in Columns 2 and 5 in Table 6. The student math achievement in first-year charter schools is .13 or .10 standard deviations lower than students in TPSs, depending on the model specification. The results are mixed for charter schools in their second year of operation. When charter schools are more established, the effect

becomes positive in both the GMM and fixed-effects models. Interestingly, the positive effect did not go away when charter schools exist for 6 or more years, as indicated in the HLM models.

The GMM models also estimate the influence of past performance on the current performance, which depreciates at a rapid rate estimated as $\theta = .02$ for elementary math. The rate is somewhat larger for language arts but remains small in magnitude, .06 in elementary schools and .12 in secondary schools. These results are consistent with previous research, indicating the assumption of no decay of the effect of prior input in the restricted value-added fixed-effects model is false and the GMM estimates are more reliable (Sass, 2006).

Again, the structural movement of students is associated with negative achievement changes, a result similar to the HLM results. On the other hand, non-structural movement has shown positive effects on student achievement, which is the opposite of the HLM results. When further categorizing student mobility, however, we find that most of the transfers have effects that are consistent with the HLM results. The only difference is that while transitions between TPSs are estimated to have a negative effect on student achievement in the HLM models, they seem to have a positive effect in the fixed-effects models. This result might reflect different transfer patterns between the two different samples of students that were used in the HLM and fixed-effects analysis. Nevertheless, after controlling for student mobility, the charter school effect become less negative in their start-up years and more positive in later years, as indicated in Columns 3 and 6. This further suggests that charter schools are less effective than TPSs in accommodating the newly transferred-in students in learning.

Table 7 and Table 8 present the estimates of the impact of charter schools on elementary and secondary language arts achievement, respectively. Similar to the HLM results, while elementary charter school students experience lower achievement gains in language arts than

TPS students, the secondary charter school students in general gain as much as TPS students. The trends of the performance gains associated with years in operation are also similar to the HLM results. The longer a charter school exists, the better its students perform in language arts. It takes five years for elementary charter schools to perform as well as TPSs, while the newly established secondary charter schools perform the same level as TPSs. When they gain more experience after about four years, they actually perform better than TPSs in language arts. As with the HLM models, structural mobility of students has a negative effect on language arts test score gains. However, the estimated effects of non-structural student mobility are less consistent. Once the student mobility is controlled, charter schools seem to demonstrate less negative effects on elementary language arts and no significant difference on secondary language arts.

All the specifications with results reported in Tables 6-8 also include a set of time-varying student and school characteristics. Time-invariant variables, such as gender and race, are not included because they do not change over time and cannot be estimated through the fixed-effects models.

7. DISCUSSION

As charter school programs vary widely across the states, it is important to evaluate their effectiveness in different settings. Utah provides an interesting case to study. There has been significant growth in both the number of and the enrollment in charter schools since their emergence in the state in 1998 as a public school choice alternative. Numerous factors contribute to this growth in Utah. First, current statute does not impose caps on the number of or enrollment in Utah charter schools. Second, as most charters began as elementary schools, the demand for middle and high schools continues to require subsequent grade-level schools for

families who have selected them as their public school alternative. Despite their growth in the state, Utah charter schools enroll a significantly lower proportion of disadvantaged students, i.e., students of color and students from low-income families than TPSs.

As charter schools are advocated as a means to improve student achievement, it is interesting to examine their effectiveness in the unique setting of Utah. This paper is the first step to understand the average effect of charter schools on student achievement in Utah. Utilizing longitudinal student-level data, we are able to use two different methods, HLM growth models with matched samples and student fixed-effects regressions, to compare student achievement gains in charter schools and TPSs. Since the two approaches suffer from different potential biases, their results are compared as a robustness check. As our analysis indicates, although the magnitudes of the estimated charter school effect vary slightly in different methods and specifications; the directions of the effect remain consistent. This indicates that it is likely that both methods have effectively controlled the student self-selection biases. The remaining potential bias does not pose any serious problems in our study and the estimated charter school effect is likely to be accurate.

Our analysis shows that Utah charter schools on average perform slightly lower than TPSs in elementary math and language arts and about the same in second language arts. Importantly, the negative results are mainly driven by the newly established charter schools. Among the 65 charter schools included in the analysis, 46% have been open no more than three years. These schools may experience significant start-up difficulties (e.g., staffing, adequate resources, and materials) and are less effective in cultivating integrated learning environments for students. As they mature, however, elementary charter schools perform similarly as TPSs in language arts and better in math. In addition, newly established secondary charter schools

perform as well as TPSs. As they gain experience through the years, charter schools generally perform slightly better than TPSs in language arts. The magnitudes of all effects are relatively small, however, mostly within .10 standard deviations.

As a public school alternative, it is important that policies support and maintain the development of charter schools in comparable ways to the TPSs. Our analysis shows that charter schools tend to suffer from start-up difficulties and benefit from the vintage effect. Although this reflects results of other studies (Booker et al., 2007; Sass, 2006), we suggest that further state and local attention be given to the infrastructure necessary to ensure that neither instructional time nor student growth are lost. The USOE Charter School Division has a robust website that provides resources on charter school application process, compliance, legislation and regulations, funding, and even parent resources. This Division also prepares an annual report on all charter schools in the state, including an emphasis on academic performance. Despite the State's effort to adequately train and prepare new charters for the tasks and responsibilities ahead, policies and guidance from the state and local education agencies regarding charter school operations may be necessary prior to schools opening. In this regard, providing infrastructure and structure to provide a seamless transition to the charter school may help mitigate the negative effects currently observed. Determining readiness of the charter school, teachers, and students and their families is an area that needs further attention in both the policy and practice arena. In addition, since charter schools, by definition, are enrolled by choice, it is expected they have high student mobility, especially in their early operational years.

Our analysis indicates that different types of student mobility in charters tend to have different effects on student achievement. In most of the estimated modes, transfers between TPSs and between charters tend to have small negative or no effect on student achievement. By

contrast, student transfers from TPSs to charter schools consistently show negative achievement gains, especially in elementary schools, while in some cases the transfers from charter schools to TPSs actually have positive effects on student achievement. This raises questions regarding a charter schools' ability and effectiveness, as compared to TPSs, to integrate new students into the classroom culture and learning environment. Given the fact that newly-established charter schools tend to have much higher student turnover rates than more established charter schools, part of the negative effect of charter schools in their early development may be attributed to this condition. It is necessary for charters and local education agencies to provide extra support to better prepare them to integrate new students. In addition, policies that can minimize the revolving door between schools will further moderate the negative effects currently experienced by charter schools early in their development.

Next, much of the literature on charter schools refers to the need for "good management." A charter may be revoked in Utah, for example, as a result of poor management of planning and resources. Certainly, given the independence, governance structures, and parameters guiding charter school operations, management skills may be necessary, but the skills may also be insufficient. Research demonstrates the pivotal role of a principal as instructional leader (Hallinger & Heck, 1996; 1998), including their necessary high quality preparation. For instance, our knowledge of the school leader's role has been informed by Cuban (1988) with regard to the broader ideals of this role to be a balance of the political, managerial, and instructional role. Given the context of charter schools, applicable skills in all three areas is important. Although aspects of a charter school leader's work may involve tasks and/or responsibilities different than the typical principal, the ultimate goal of increasing learning opportunities is similar. Yet, we have scarce research in this area, particularly in a context such

as Utah. Our research, particularly in Utah, needs to further explore how both the charter school leadership, including the charter board, defines and executes its role and what impact this has on the charter's ability to fully serve the academic development of its students. With regard to charter schools, understanding how a school leader shapes the school's mission and the attainment of the mission is imperative.

Finally, based on our results, Utah charter schools do not seem to be a better solution than TPSs in addressing issues of low performance. Our analysis, however, focuses only on the average charter school effect on student achievement. The mission of charter schools, however, is generally more heterogeneous than TPSs. Future research is needed to examine the distribution of effective charter schools, including by mission, and to identify the most effective ones and their successful practices, particularly those charters that are able to mitigate the negative effects often associated with early start-up. In addition, we have only considered performance on state administered criterion reference tests here; other academic and non-academic outcomes need further attention in our research. For example, many parents in Utah choose charter schools not because of their overall academic performance. Instead, they choose charters because of issues related to their child's anticipated academic success and safety, perceived school or teacher innovation, access to decision-making and control, and schools with children more similar to the characteristics of their child, and convenience (Rorrer, Hausman, & Groth, 2006). Moreover, even if charter schools do not perform better than TPSs, they may still be perceived as a more attractive choice if students are better matched with a particular charter school mission than their assigned public schools.

We suspect that the debate nationally over charter school effectiveness and viability as a choice to traditional public schools will continue to gain attention. Even so, we anticipate that

these findings may not drive families to not choose charter schools; nor should it necessarily. While effectiveness of any school remains relevant to the policy, practice, and research community, we suggest that this debate may overshadow other issues of consequence such as those identified here. As this research demonstrates, attention to the larger issue of policies and structures needed to more readily assure comparable learning and achievement opportunities for the students who attend are needed in tandem with questions about relative effectiveness. Moreover, the findings from this study can be useful in providing directions for decisions regarding when to enroll students in charter schools, as well as inform questions that families may ask regarding stability and readiness of charters.

Table 1 Descriptive analysis for charter schools and traditional public schools, 2004 and 2009

	2003-2004			2008-2009		
	Charter school (*n*=2717)	TPS (*n*=394160)	Diff	Charter school (*n*=23977)	TPS (*n*=443239)	Diff
Total Enrollment	0.68%	99.32%		5.13%	94.87%	
% Asian	1.73	1.63	0.1	1.94	1.73	0.21
% Black	1.73	1.18	0.55	1.59	1.48	0.11
% Caucasian	85.09	82.83	2.26	83.24	78.14	5.1
% Hispanic	7.29	11.06	-3.77	9.31	14.97	-5.66
% American Indian	2.69	1.63	1.06	0.92	1.56	-0.64
% Pacifica islander	1.36	1.41	-0.05	1.38	1.61	-0.23
% unidentified	0.11	0.25	-0.14	1.63	0.52	1.11
% FRL	16.08	34.15	-18.07	22.64	35.10	-12.46
% ELL	0.77	6.03	-5.26	1.32	6.82	-5.50
% special education	8.17	12.48	-4.31	11.12	12.40	-1.28
Math scaled score	166.06	164.99	1.07	164.51	163.07	1.44
Language arts scaled score	167.63	166.50	1.13	168.53	167.27	1.27

The core and the scale for math CRT has changed in 2009, so it is inappropriate to compare math CRT scores in 2009 with those in 2004.

Table 2 Student mobility in charter school and traditional public schools, between 2007-2008 and 2008-2009

Grade	From Charter school			From TPS		
	To another charter school	To TPS	Out of Utah public school system	To another TPS	To charter school	Out of Utah public school system
1	1.4	9.2	7.1	13.6	1.3	5.7
2	1.8	8.4	5.9	14.6	1.3	5.3
3	1.0	9.4	6.2	13.2	1.2	5.0
4	2.3	10.8	6.7	12.5	1.4	5.0
5	1.8	11.6	7.1	25.7	1.3	5.8
6	5.1	25.9	10	75.5	1.4	4.8
7	5.1	13.6	7.3	16.6	0.9	4.5
8	19	26.3	15.5	22.4	1.8	4.8
9	7.0	30.8	12.4	72.6	1.5	5.4
10	1.9	17.2	11.7	9.0	1.0	6.8
11	0.5	12.5	14.5	8.1	0.5	10.2
Total	3.8	15	8.8	25.3	1.3	5.7

Table 3 Non-structural and structural move between charter schools and TPSs, between 2007-2008 and 2008-2009

	Charter schools		TPSs	
Grade	Structural	Non-structural	Structural	Non-structural
1	0.0	10.6	0.4	14.5
2	0.0	10.2	1.8	14.0
3	0.5	9.9	0.7	13.7
4	0.0	13.1	0.5	13.4
5	2.2	11.2	17.8	9.2
6	11.6	19.5	73.5	3.3
7	0.0	18.8	11.0	6.5
8	29.3	16.0	15.1	9.1
9	20.4	17.4	69.3	4.8
10	0.3	18.7	0.0	10.0
11	12.9	0.0	8.7	0.0
Total	5.6	13.1	17.3	9.2

Table 4 Baseline characteristics of matched charter school students and TPS students

	Charter school	Traditional public schools
Total Enrollment	20215	20215
Asian	1.64	1.40
Black	1.60	1.60
Caucasian	86.08	86.08
Hispanic	7.90	7.90
Indian	1.44	1.44
Pacifica islander	1.15	1.15
Unidentified	0.21	0.21
% FRL	26.43	26.43
% ELL	2.74	2.74
% special ed	9.95	9.95
Math scaled score	167.05	167.04
Language arts scaled score	168.41	168.33

All the characteristics are based on the information from **the year before** a charter school student first appeared in the database and her match.

Table 5 The effects of charter school attendance on student achievement: HLM growth curve modeling

	Math grades 1-6			Language arts grades 1-6			Language arts grades 7-11		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Growth rate	.027**	.025**	.025**	.008	.007	.007	-.046**	-.046**	-.046**
	(.006)	(.006)	(.006)	(.006)	(.006)	(.006)	(.004)	(.004)	(.004)
Charter school	-.041**			-.09**			-.001		
	(.008)			(.007)			(.009)		
1st year		-.116**	-.092**		-.138**	-.129**		-.057**	-.035
		(.011)	(.013)		(.009)	(.012)		(.016)	(.02)
2nd year		-.047**	-.0327**		-.104**	-.099**		-.01	.009
		(.010)	(.011)		(.009)	(.009)		(.014)	(.016)
3rd year		.052**	.015		-.079**	-.073**		-.012	.005
		(.015)	(.013)		(.009)	(.01)		(.013)	(.015)
4th year		.050**	.0643**		-.058**	-.053**		.008	.023
		(.016)	(.016)		(.011)	(.012)		(.015)	(.016)
5th year		.138**	.1529**		.02	.026		.063**	.079**
		(.018)	(.019)		(.014)	(.014)		(.018)	(.019)
6th year/more		-.020	-.004		-.004	.001		.036*	.051**
		(.023)	(.024)		(.015)	(.015)		(.018)	(.019)
Mover	-.056**	-.035**		-.024**	-.011*		-.06**	-.055**	
	(.006)	(.006)		(.005)	(.005)		(.009)	(.009)	
TPS-to-TPS mover			-.035**			-.013			-.065**
			(.008)			(.007)			(.011)
TPS-to-charter mover			-.063**			-.02*			-.082**
			(.011)			(.01)			(.014)
Charter-to-TPS mover			.042**			.030*			.023
			(.021)			(.015)			(.014)
Charter-to-charter mover			-.014			-.02			-.019
			(.026)			(.023)			(.024)
Structural mover	-.106**	-.117**	-.113**	-.055**	-.06**	-.057**	-.023**	-.021*	-.02*
	(.020)	(.020)	(.020)	(.017)	(.017)	(.017)	(.01)	(.01)	(.01)
FRL	-.093**	-.094**	-.094**	-.088**	-.089**	-.089**	-.131**	-.131**	-.131**
	(.007)	(.007)	(.007)	(.006)	(.006)	(.006)	(.01)	(.01)	(.01)
Special ed.	-.400**	-.400**	-.400**	-.324**	-.324**	-.324**	-.68**	-.68**	-.681**
	(.011)	(.011)	(.011)	(.008)	(.008)	(.008)	(.016)	(.016)	(.016)
ELL	-.194**	-.196**	-.196**	-.204**	-.206**	-.206**	-.391**	-.39**	-.391**
	(.020)	(.020)	(.020)	(.018)	(.018)	(.018)	(.034)	(.034)	(.034)
Deviance	263275	263111	263109	289066	289034	289050	95207	95253	95246
# of obs		115110			133378			51358	
# of students		36336			36330			19616	

A set of grade dummies and year dummies are included in the level-1 models across all specifications. Other control variables in the level-1 model in all specifications also include time-varying school characteristics: % Black in school, % Hispanic in school, % Asian in school, % Free/reduced lunch in school, % ELL in school, and % special ed. in school. These results are not reported here. The time invariant variables in the level-2 model include: gender, Hispanic, Black, and Asian. The results of level-2 models including intercept and growth and charter school slopes are not reported here.

* Statistically significant at .05 level, ** statistically significant at .01 level. Robust standard errors are reported in the parentheses.

Table 6 Estimated effects of charter school attendance on student math achievement, grades 1-6

	Fixed effects			Dynamic panel GMM		
	(1)	(2)	(3)	(4)	(5)	(6)
$Achievement_{t-1}$				.02**	.021**	.021**
				(.003)	(.003)	(.003)
Charter school	-.015			-.05**		
	(.016)			(.011)		
1^{st} year charter		-.127**	.009		-.095**	-.042
		(.021)	(.037)		(.014)	(.026)
2^{nd} year charter		.043*	.103**		-.035**	-.006
		(.018)	(.021)		(.013)	(.016)
3^{rd} year charter		.051*	.111**		.013	.042*
		(.023)	(.024)		(.016)	(.018)
4^{th} year charter		.036	.096**		.012	.041
		(.029)	(.03)		(.021)	(.022)
5^{th} year charter		.097**	.157**		.086**	.116**
		(.034)	(.035)		(.026)	(.027)
6^{th} year and more charter		.108*	.17**		.053	.084*
		(.044)	(.045)		(.035)	(.036)
Mover	.008	.015**		.001	.004	
	(.005)	(.005)		(.003)	(.003)	
TPS-to-TPS mover			.016**			.004
			(.005)			(.003)
TPS-to-charter mover			-.091**			-.034
			(.026)			(.017)
Charter-to-TPS mover			.135**			.042
			(.033)			(.022)
Charter-to-charter mover			-.021			-.024
			(.052)			(.032)
Structural mover	-.07**	-.076**	-.075**	-.039**	-.042**	-.042**
	(.009)	(.009)	(.009)	(.006)	(.006)	(.006)
Special education	.077**	.077**	.077**	.037**	.037**	.037**
	(.009)	(.009)	(.009)	(.007)	(.007)	(.007)
English Language learner	.027*	.026*	.025*	-.027**	-.027**	-.027**
	(.013)	(.013)	(.013)	(.009)	(.009)	(.009)
# of obs.		720293			489604	
# of students		230689			230688	

All models include year/grade fixed effects. All models also include time-varying school characteristics: % Black in school, % Hispanic in school, % Asian in school, % Free/reduced lunch in school, % ELL in school, and % special ed. in school. These results are not reported due to space constraints. Robust standard errors are in parentheses. * Statistically significant at .05 level, ** statistically significant at .01 level.

Table 7 Estimated effects of charter school attendance on student achievement of Language Arts, grades 1-6

	Fixed effects			Dynamic panel GMM		
	(1)	(2)	(3)	(4)	(5)	(6)
$Achievement_{t-1}$				.062**	.057**	.057**
				(.003)	(.003)	(.003)
Charter school	-.066**			-.099**		
	(.012)			(.01)		
1^{st} year charter		-.152**	-.039		-.128**	-.136**
		(.017)	(.027)		(.012)	(.021)
2^{nd} year charter		-.018	.043*		-.095**	-.091**
		(.015)	(.017)		(.012)	(.014)
3^{rd} year charter		-.036*	.018		-.081**	-.080**
		(.015)	(.016)		(.013)	(.014)
4^{th} year charter		-.054**	0		-.078**	-.071**
		(.019)	(.02)		(.015)	(.017)
5^{th} year charter		.038	.093**		-.02	-.021
		(.024)	(.025)		(.019)	(.02)
6^{th} year and more charter		.018	.069*		.004	.005
		(.027)	(.027)		(.024)	(.025)
Mover	.022**	.027**		.01**	.012**	
	(.004)	(.004)		(.003)	(.003)	
TPS-to-TPS mover			.026**			.011**
			(.004)			(.003)
TPS-to-charter mover			-.06**			-.021
			(.019)			(.014)
Charter-to-TPS mover			.167**			.027
			(.023)			(.017)
Charter-to-charter mover			.034			.017
			(.043)			(.028)
Structural mover	-.059**	-.063**	-.061**	-.038**	-.041**	-.04**
	(.007)	(.007)	(.007)	(.005)	(.005)	(.005)
Special education	.124**	.124**	.124**	.067**	.068**	.068**
	(.007)	(.007)	(.007)	(.006)	(.006)	(.006)
English Language learner	.064**	.064**	.063**	-.029**	-.032**	-.032**
	(.009)	(.009)	(.009)	(.007)	(.007)	(.007)
# of obs.		720574			489766	
# of students		230808			230807	

See Table 6 for notes.

Table 8 Estimated effects of charter school attendance on student achievement of Language Arts, grades 7-11

	Fixed effects			Dynamic panel GMM		
	(1)	(2)	(3)	(4)	(5)	(6)
$Achievement_{t-1}$				.117**	.117**	.117**
				(.006)	(.006)	(.006)
Charter school	.037*			.019		
	(.016)			(.013)		
1^{st} year charter		.026	.051		-.001	-.016
		(.032)	(.042)		(.022)	(.032)
2^{nd} year charter		.023	.038		-.004	-.008
		(.023)	(.027)		(.017)	(.022)
3^{rd} year charter		-.026	-.014		-.018	-.04
		(.025)	(.028)		(.019)	(.023)
4^{th} year charter		.046	.056*		.03	.01
		(.025)	(.027)		(.02)	(.023)
5^{th} year charter		.12**	.129**		.087**	.065
		(.032)	(.033)		(.026)	(.028)*
6^{th} year and more charter		.096*	.105**		.079**	.059
		(.038)	(.038)		(.029)	(.03)
Mover	.011	.011		-.007	-.007	
	(.007)	(.007)		(.005)	(.005)	
TPS-to-TPS mover			.011			-.008
			(.007)			(.005)
TPS-to-charter mover			.002			-.017
			(.022)			(.017)
Charter-to-TPS mover			.036			.017
			(.025)			(.018)
Charter-to-charter mover			-.055			-.06
			(.051)			(.035)
Structural mover	-.075**	-.075**	-.074**	-.02**	-.02**	-.019**
	(.007)	(.007)	(.007)	(.005)	(.005)	(.005)
Special education	.047**	.047**	.047**	0	0	0
	(.018)	(.018)	(.018)	(.015)	(.015)	(.015)
English Language learner	.013	.012	.012	-.049**	-.049**	-.049**
	(.017)	(.017)	(.017)	(.013)	(.013)	(.013)
# of obs.		502743			325336	
# of students		177398			177136	

See Table 6 for notes.

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