The Effect of Charter Schools on Achievement and Behavior of Public School Students:

Scott A. Imberman [1]

University of Houston

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Abstract: Charter schools are the most popular form of school choice in the US. However, we know little about how these schools affect traditional public schools. I look at how charter schools affect achievement, behavior, and attendance in nearby traditional public schools using data from a large urban school district in the southwest. I address the endogenous location of charter schools using an instrumental variables strategy. My results show that when charter school penetration increases, students suffer modest but statistically significant drops in math and language score gains. However, achievement losses are potentially offset by improvement in discipline.

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[1] 204 McElhinney Hall, Houston, TX 77204-5019. simberman@uh.edu. I would like to thank the Maryland Population Research Center for their financial support for this project. I extend my sincerest gratitude to employees and administrators at an anonymous school district and county tax-appraisal office for providing me with data and assistance and for making this project possible. I'd especially like to thank Mark Duggan for his many years of help with this work. In addition, I am grateful for guidance and assistance provided by Aimee Chin, Steve Craig, Julie Berry Cullen, Judy Hellerstein, Bill Evans, Ginger Zhe Jin, Chinhui Juhn, and Jennifer King Rice along with participants at NYU and the 2007 AEFA Annual Meetings. Finally, thanks to Mikailo Situk for excellent research assistance. Portions of this project were conducted at the University of Maryland as part of my doctoral dissertation. All errors remain my own.

1 Introduction

Charter schools have become one of the most controversial issues in education today. While proponents argue that charters will provide innovative education to students and will spur traditional public schools to improve through competitive pressures, opponents argue that charters drain the public school system of funding leaving those who cannot enter the charters worse off.[1] Despite this controversy, since 1997 the number of charter schools in the US has increased more than fivefold, and the number of students has more than doubled since 1999. Today, over a million students attend charter schools. In some states, the charter population is a substantial portion of the total student population. For example, ten percent of students in Arizona attend charter schools.[2]

Charter schools are public schools that are given autonomy from local school districts and are subject to fewer regulations than regular public schools. Generally, enrollment in charters is voluntary and public schools lose some funding if a student leaves for a charter. Proponents of charters have argued that this threat of losing students should induce public schools to improve student outcomes. However it is theoretically unclear whether this is true and only a handful of papers have looked at the empirical evidence of how charter schools affect students in traditional public schools using individual data (Booker, Gilpatric, Gronberg and Jansen 2008, Bifulco and Ladd 2006, Sass 2006). In this paper I address this question using data from a large urban school district in the southwest (LUSD-SW) to look at charter impacts on test scores and student behavior.

While this paper will look at the reduced form impacts of charter schools on traditional public schools (TPS), it is useful to think about what mechanisms may be at play. The most commonly cited is a competition effect. When a charter school enrolls a student they usually receive money from the chartering authority. Some portion of this funding usually would have gone to the local public school had the student not left for the charter. Thus there is a financial incentive for public schools to prevent students from attending charter schools.[3] In addition, in the long-run a school

[1]Throughout this paper the term "traditional" public schools refers to any public non-charter school.

[2]Author's calculation from data provided by Center for Education Reform and National Center for Education Statistics, US Department of Education.

[3]In the state where LUSD-SW is located, the school district loses state aid for the student. While the amount lost depends on the type of student, i.e. whether the student is economically disadvantaged, special education, gifted, etc., the marginal student from LUSD who is not in a special category would cost the school district \$2843 in 2005, or 46% of per-student expenditures. In 2002 losing a marginal student would have cost \$4580 or 67% of per-student expenditures.

may lose enough students to the charters so that it is forced to shut-down due to low enrollment. If these two incentives spur public school teachers and administrators to increase effort and efficiency, then charters would generate a positive competition effect on public schools. On the other hand, if charters are pulling too many students from one school, districts may "give-up" and reallocate funding towards other schools. In addition, some theoretical work by Cardon (2003)?cardon2003sqc) suggests that if there are capacity constraints on charters then public schools may not respond to charter competition. Indeed, if public schools are overcrowded, they may welcome the charter schools, since they would serve as a release valve.

Even without an explicit response from the school district, charters can impact traditional public schools. For example, if charters pull enough students out of a public school, the principal may have to reduce faculty and staff. While this may be good in the long-run, in the short-term it could reduce morale while generating confusion and uncertainty. In addition, new charter schools or expansions in existing schools may be disruptive by drawing away a large number of students at once, forcing the local public schools to cope with a sudden drop in funding by cutting costs. Over the long-term the schools will likely adapt, but in the short-run only certain costs may be able to be cut such as teacher and staff hiring, after school programs, or additional instruction. Charters may also attract better teachers from regular public schools, leaving worse teachers behind. Another possibility is that if charters attract only certain types of students, then the characteristics of the peers for students who remain in traditional public schools may change. Thus charters can induce impacts on student outcomes through peer-effects.

Even if we are to abstract away from the mechanism of charter impacts on traditional public schools, identifying the effects of charter schools on TPS students is problematic because neither a student's choice of what school to attend nor a charter school's choice of where to locate are random. Thus, any study of charter school impacts on non-charter students must account for these two potential types of selection bias. Previous work has used student fixed-effects to account for endogenous movements of students and school fixed-effects to account for charter location (Booker et al. 2008, Buddin and Zimmer 2005, Bifulco and Ladd 2006, Sass 2006).[4] However, we may be concerned that panel data methods are insufficient for eliminating bias in the charter competition context. In particular, while student fixed-effects may be a sufficient correction student selection, selection of charter locations could be based off of

[4]Booker et. al. (2008) also make use of student-spell fixed effects so that their estimates are identified off of changes in charter penetration while a student is enrolled at a specific school.

local trends in public school quality and thus school-fixed effects will not completely address the bias.

Thus, in this paper, I use an alternative technique to addressing endogenous charter location than the prior literature by using characteristics of the building stock near traditional public schools as instruments for charter location. The intuition behind this is that when a charter is started, one of the most restrictive constraints is finding space available for rent.[5] In particular, I use the number of properties near a traditional public school with between 20,000 and 50,000 square feet of building space and the number of properties that host shopping centers, which charters in LUSD commonly locate in. I argue that these supply constraints on new charters are plausibly exogenous sources of variation in charter location.

In addition, I also add to the previous literature by looking at discipline and attendance of TPS students in addition to test scores. Based on findings from Heckman, Stixrud and Urzua (2006) that non-cognitive skills are correlated with poor behavior, Imberman (2008) argues that the combination of student discipline and attendance provides a proxy for non-cognitive skills. Using this strategy, he finds that charter schools in LUSD are more effective at improving non-cognitive skills of students but not cognitive skills. Thus it seems reasonable that public schools could respond by focusing on student safety and discipline to encourage students to stay in public schools. This may be particularly important since Weiher and Tedin (2002) find that discipline and safety are drive many parents' decisions to enroll their children in charters.

Regressions using school fixed effects show a somewhat positive impact of charter schools on TPS test scores which is consistent with much of the previous literature. However, IV estimates show negative and statistically significant impacts on math and language test score gains. There is no statistically significant impact on reading gains. These results suggest that analyses which rely on school fixed effects to address endogenous location of charter schools may suffer from bias. They also imply that, in the short-term, charter schools can be detrimental to the academic performance of non-charter students. Nonetheless, I do find a silver lining in the results. Charter schools appear to induce significant drops in disciplinary infractions in non-charter students. However, since I do not find a corresponding improvement in attendance, I cannot establish whether this is truly an improvement in non-cognitive skills or changes in enforcement.

[5]While some charters purchase land, since relatively little start-up capital is provided by public sources, most charters in LUSD-SW rent their space or use donated space

2 Background

Previous Literature

A substantial amount of research has looked at how charter schools affect student outcomes (Hoxby and Murarka 2008, Imberman 2008, Booker, Gilpatric, Gronberg and Jansen 2007, Hanushek, Kain, Rivkin and Branch 2007, Bifulco and Ladd 2006, Sass 2006, Hoxby and Rockoff 2004, Zimmer and Buddin 2003). While the estimates of how charter schools affect test scores have been mixed, Imberman (2008) provides evidence of improvements in student discipline and attendance in certain types of charter schools. On the other hand only a handful of papers have considered how charter schools affect non-charter students. Some early work on the topic has used school level data to answer this question. Bettinger (2005) finds little effect of charter schools on public schools while Hoxby (2004) and Holmes, Desimone and Rupp (2003) find positive effects of charter schools on public schools. While these papers were instrumental in starting this line of literature, since all outcome measures are aggregated to the school level it is impossible to tell whether these results are due to charter competition or changes in the student body composition.

Recent work on whether charter schools affect non-charter students have turned to individual panel data in order to address concerns regarding changes in composition. In addition, panel data can be used to account for unobserved heterogeneity of students across different levels of charter penetration, as long as the selection of students into schools near or far from charters is based on time-invariant characteristics. Sass (2006) and Booker, et. al. (2008) find that charter schools have positive impacts on traditional public schools while Bifulco and Ladd (2006) and Buddin and Zimmer (2005) find statistically insignificant impact estimates. Thus, in general, researchers have found that charter schools have, at worst, no significant effect on achievement in non-charter public schools and, at best, a large positive effect.

3 Charter Schools in LUSD

LUSD-SW was one of the first school districts in the US to face competition from charter schools. Both district and state authorized schools began appearing in 1996. Figure 1 shows the evolution of charter openings in LUSD's county over time. Each of these types of schools experienced substantial growth over the time period studied in this paper. In 2004-05 this growth culminated in 99 charter schools of which 73 schools were chartered by the state or a university while 26 were chartered by LUSD-SW directly.[6] Charter schools account for a large portion of student enrollment in LUSD. Enrollment in district charters in 2004-05 is equal to 6% of non-charter enrollment and state charters have enrollment equivalent to 9% of non-charter enrollment in LUSD. Figure 2 shows how the average share of students within 1.5 miles in overlapping grades who are in charter schools changes over time. The growth matches closely to the growth in the number of charter schools up to 2002 when growth in charter share slows. Nonetheless, both of these figures show that traditional public schools experienced considerable increases in their exposure to charter schools over the years covered in this study.

While it may be interesting to differentiate between the effects of district and state charters, unfortunately my instrument is too weak for district charters.[7] Nonetheless, the most substantial competition is likely to come from the state charters since LUSD-SW loses state aid when a student leaves for these charters but not for district charters. In addition, the local school district cannot control where state charters locate, which is important for competitive pressures to be effective.

Table 1 provides summary information on traditional public schools and state charters for the years 1998 - 2004, as prior to 1998 there were very few charters in LUSD. The first column in each grade-level includes all non-charter schools in LUSD-SW. Charter students differ substantially from non-charter students. Charter students are generally wealthier and are less likely to have special needs, as shown by the lower rates of limited English proficiency, special education, and gifted & talented. Charters also attract disproportionately fewer African-Americans and more Hispanics. The white population of charters, while slightly lower, does not statistically significantly differ from non-charter schools. However, despite the higher wealth status of charter students, their test score performance is lower than non-charter students. Thus, these results suggest that charter students tend to be low-performers who do not have special needs.

[6]Only two schools have university charters. Since they are independent of LUSD, I include them in the "state charter" category.

[7]This is mainly due to two reasons. The first is that some district charters are conversions which were previously regular public schools and thus do not need to search for alternative locations. The second is that, after removing the conversion charters, the number of district charters remaining is 17, leaving little variation across regular public schools.

4 Data

In this paper I utilize administrative records from a large urban school district int the southwest. This dataset includes information on disciplinary infractions warranting an in-school suspension or harsher punishment, attendance, rates scores from the Stanford Achievement Test versions 9 and 10, a criterion-referenced state examination, grades, course work, and a number of student characteristics. A full accounting of the variables used in this paper with definitions can be found in Appendix Table 1. The data cover the 1993-1994 to 2004-2005 academic years and I am able to follow individual students for as long as they attend school in LUSD, providing a long time-series on many students. After dropping students in pre-school or kindergarten, with missing data, or in charter schools, 55% of students who are first observed in the data prior to ninth grade have at least four observations.

Since not all students take the Stanford Achievement Test, which is a norm-referenced examination, and test data are only available starting in 1998, I generate two samples.[8] I call the first sample the "behavior sample." This sample is used when analyzing discipline & attendance. It includes students in grades 1-12 who were enrolled as of the end of October of each year, since this is when demographic information is collected by the district. The demographic files identify the school a student attends and thus I use this as the student's school for the year. Some observations ($< 0.1\%$) are excluded due to missing attendance data.

I call the second sample the "test sample," which includes all students in the behavior sample from 1999-2004 who have scores recorded for the mathematics, reading, and language portions of the Stanford 9/10 examination in both the current and previous years so that I can generate test-score gains. If any one of these tests are missing I drop the observation so that all three test scores are analyzed using the same sample. Stanford 9/10 was given to all English-speaking students in grades 1-8 and all students in grades 9-11. This provides wider coverage of grades than previous work on charter schools, since most districts and states do not start testing until third grade and often stop testing by eighth grade. Students who were not proficient enough in English in grades 1-8 took the Spanish language Aprenda exam.[9]

[8]Norm-referenced examinations are tests which are scaled to match a representative sample of students in the same grade. Some papers use criterion-referenced examinations instead, which are exams where the student's grade is based on a set of absolute standards.

[9] Twenty-four percent of elementary student-year observations in the base sample have no test score because they take the Spanish language exam, but by the time students reach middle school, almost all are taking the English language exam. In high school, 23% of student-years in the base sample are missing test scores. This is mostly due to students dropping out of school or moving

While I have data on these exam results, the scores are not directly comparable to those of students taking the English exam.[10]. After creating both samples, I drop any students enrolled in district charter schools so that the focus of the study is how the state charter schools affect the traditional public schools. This leaves 2,049,076 student-year observations in the base sample and 583,091 student-year observations in the test sample.

School addresses were identified from the US Department of Education's Common Core of Data. Any missing addresses were filled in using school directories acquired directly from LUSD-SW. These addresses were then converted to latitude and longitude using the geocoder.us website. If an address could not be matched using geocoder.us then I used Google Earth™ to find the latitude and longitude.[11] Afterwards, distances between schools were derived using the sphdist command in Stata™. Data on local building stock comes from LUSD-SW's county tax appraisal district. Schools were matched to plots with the appropriately sized buildings using ArcGIS™. Economic characteristics of census tracts were obtained from the 2000 Census Summary Files.

Tables 2A and 2B provide summary statistics from 1998 - 2004 for schools that are between the 0^{yh} and 64^{th}, 65^{th} and 74^{th}, 75^{th} and 89^{th}, and 90^{th} and 99^{th} percentiles of charter penetration within 1.5 miles, which is the distance I use to calculate charter penetration. Charter penetration is defined the fraction of students in schools within 1.5 miles and in grades covered by the observed school who attend state charters. A more detailed description of how this variable is constructed and an explanation for why I choose a distance metric of 1.5 miles is provided in the empirical strategy section below. Schools with charters nearby tend to more students who are free-lunch eligible, at-risk, LEP, and immigrants. In terms of student outcomes, schools with charters nearby differ little from schools without charters nearby.

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out of the district between October and the testing period in late winter. Some students also are missing test scores due to illness or suspension during the testing period.

[10]Unfortunately, regressions looking at Aprenda scores only provided estimates that were too imprecise to draw any conclusions. Estimates of the main model that include Aprenda scores when Stanford 9/10 are missing along with dummies for year interacted with whether the student took the Aprenda test provide qualitatively similar results.

[11]For a small number of schools addresses could not be matched to a location. Students in these schools were dropped from the analysis.

5 Empirical Strategy

Endogenous Student Movements and Charter Location

Estimates of the impacts of charter schools non traditional public schools are potentially biased by two types of selection. First, a parent's choice of school is not random. Thus we may be concerned that parents would select into or out of schools near charters for unobservable reasons that are correlated with student ability and behavior. Perhaps more importantly, it is likely that some parents respond to observed changes in traditional public schools that result from charter competition. For example, suppose charters do generate positive competition effects in non-charter schools. Some parents with high achieving students who planned to send their children to magnet or private schools may now decide to keep their children in their newly improved neighborhood school, thus increasing the estimated charter impact. To address this problem I follow the previous literature by incorporating student fixed-effects into the regressions. This will sufficiently correct for student selection if the selection is based on time-invariant characteristics of the students, such as their parents' motivation.

Second, the location of charter schools is non-random. Charter location may be affected by space availability, transportation options, economic conditions, and the quality of nearby public schools. This is not a problem if these factors are uncorrelated with student and traditional public school characteristics. However there may be higher demand for alternative schooling options in areas with low-performing schools. Indeed, many charters are created through grass roots organizing in a community, often in response to the poor quality of the local schools.

Depending on the nature of this selection, the bias in the charter impact estimates could be positive or negative. If charters locate near low-performing schools based on time-invariant characteristics of the public schools (i.e. the charters locate near schools which have been low performing for many years and have shown little improvement or worsening), then simple OLS regressions would underestimate the effects of charters. Researchers have addressed this type of selection by including school fixed-effects in OLS regressions along with student fixed-effects. However, if location is, at least partially, based on time-variant characteristics of non-charter schools then this strategy will not eliminate, and in fact may exacerbate, the bias. One possible way this can occur is if charters locate in areas where performance is worsening on the belief that this will generate higher demand in the future. Since many charters face high startup costs and thus open with few students and expand later, having an anticipated increase in demand could be desirable. Another mechanism for this selection would be if parents and community leaders start charter schools when they see performance in the public schools worsening. The direction of this type of bias depends on whether the school's counterfactual outcome trajectory.

Figures 3A and 3B provide stylized examples of how estimated and actual charter impacts may differ under two scenarios when using school fixed effects. For this example, I assume that charter impacts are positive, the mean outcomes for schools with no charter exposure are constant at 0, and a single charter school opens nearby at time t. In this case, charter impacts are estimated by taking the difference between mean outcomes after t and mean outcomes before t. The true impact would be the difference between the mean outcome after the charter opens and the mean outcome had a charter not opened nearby. In figure 3A we see that for a trend that exhibits mean-reversion, and is thus temporary, the estimated charter impact tends to underestimate the true impact. Figure 3B shows that if the trend would have continued after the charter opens, then by ignoring the trend, school-FE regressions would under-estimate the charter impacts even further.

To address this issue, I use an instrumental variables approach. I argue that characteristics of the pre-existing stock of buildings, in particular the size of building space on nearby properties and the location of both large and small shopping centers, are plausibly exogenous instruments for charter penetration near traditional public schools. I discuss these instruments in more detail below. The fact that my IV results differ considerably from fixed-effects results, suggest that analyses utilizing school fixed-effects may not remove all bias.

Baseline Model

We begin with an equation of the form

$$y_{ijt} = \alpha + \beta C^{d}_{jt} + \mathbf{X}_{ijt}\Omega + \mathbf{G}_{it}\Theta + \epsilon_{ijt} \tag{1}$$

where y_{ijt} is an outcome measure for student i in school j during academic year t, C^d is the a measure of charter penetration for state charters within a radius d of the regular public school j, $\mathbf{X}$ is a set of observable student characteristics, G_{it} is a set of grade-by-year indicators, and ϵ is an error term.

I follow Booker, et. al. (2008) and Sass(2006) in using a restricted value-added model to identify test score effects where outcomes are measured as annual gains in standard deviations of test scores.[12] For discipline and attendance, a levels model is more intuitively appealing and thus I use that framework.

ϵ can further be broken down into student and school error components

$$\epsilon_{ijt} = \gamma_{ijt} + \eta_{jt}. \tag{2}$$

The concern is that both γ_{ijt} and η_{jt} will be correlated with C^d_{jt} through some unobserved factors.

Student Selection Into Schools

One problem we face is the potential that $cov(\gamma_{ijt}, C^d_{jt}) \neq 0$, i.e. that something unobservable is driving student selection into schools facing more or less charter competition. The most obvious type of selection is that only certain types of students may leave non-charters for charter schools. As was shown in Table 1, students who attend charter schools appear to differ considerably from LUSD-SW traditional public school students. Thus the loss of these students from schools with a large amount of charter penetration could bias the results. Another type of selection is that students may remain in LUSD-SW but change schools in response to charter competition.

I use a student-fixed effects strategy to address this problem as in Booker et al. (2008), Bifulco and Ladd (2006), and Sass (2006). More precisely, I assume that

$$\gamma_{ijt} = \lambda_i + \nu_{ijt} \tag{3}$$

where $cov(\lambda_i, C^d_{jt}) \neq 0$ but $cov(\nu_{ijt}, C^d_{jt}) = 0$. Under this assumption we can remove λ from (1) by demeaning the model with respect to the individual as such

$$\tilde{y}_{ijt} = \tilde{\alpha} + \beta\tilde{C}^d_{jt} + \tilde{\mathbf{X}}_{ijt}\Omega + \tilde{\mathbf{G}}_{it}\Theta + \tilde{\nu}_{ijt} + \tilde{\eta}_{jt}. \tag{4}$$

where $\tilde{B} = B_{ijgt} - \bar{B}_i + \bar{B}$.[13]

Endogenous Charter School Location

While student fixed-effects correct for student selection under the assumption stated above, if charter location is endogenous then $cov(\tilde{\eta}_{jt}, \tilde{C}^d_{jt}) \neq 0$. One way to

[12] Sass also uses an unrestricted model that has lagged test scores as an explanatory variable. However, this model relies on the strong assumption that twice-lagged test scores are valid instruments for once lagged test scores. Since this is unlikely to be true, I do not use that empirical strategy.

[13] This is the equivalent of the method used by the "xtreg, fe" command in Stata™.

address this type of selection is to use school fixed-effects as in Bifulco and Ladd (2006), and Sass (2006)). For this strategy to be valid it must be that

$$\tilde{\eta}_{jt} = \tilde{\zeta}_j + \tilde{\theta}_{jt} \tag{5}$$

where $cov(\tilde{\zeta}_j, \tilde{C}^d_{jt}) \neq 0$ and $cov(\tilde{\theta}_{jt}, \tilde{C}^d_{jt}) = 0$. Under this assumption we can add school indicator dummies to the regression which will eliminate $\tilde{\zeta}_j$. Thus, our regression equation becomes

$$\tilde{y}_{igjt} = \beta \tilde{C}^d_{jt} + \tilde{\mathbf{X}}_{ijt}\Omega + \tilde{\mathbf{G}}_{it}\Theta + \tilde{\mathbf{S}}_{jt}\Gamma + \tilde{\nu}_{ijt} + \tilde{\theta}_{jt}. \tag{6}$$

where $\mathbf{S}$ is the vector of school indicators. However, if charters select locations based on trends in local school performance, or, similarly, if grass root efforts to create charters are spurred by trends in local schooling conditions, then equation (5) will be incorrect and including school indicators will not correct for selection. One possible solution to this problem is to use an instrumental variables strategy.

I propose using characteristics of building stock near non-charter public schools as an instrument for charter share. The idea behind this instrument is that certain types of buildings are better suited for a school then others. Often charters need to rent space or use donated space because they do not have funds available to build their own buildings. In particular, charters in LUSD often locate in shopping centers because they have a lot of space available, can be easily renovated to accommodate building classrooms, and are easy to rent. These shopping centers range in size from small strips of five units to large multi-unit commercial and retail complexes. In fact 16% of state charters in LUSD borders are located in current or former shopping centers.[14] In addition charter schools are more likely to locate on plots of land with appropriate amounts building space. If the building space is too small, then the charter will not have enough room to operate. If it is too large, then much of the space goes unused and the charter is unlikely to be willing to pay the rent premium. In addition, properties with particularly large amounts of building space are often hi-rise office buildings, warehouses and apartment complexes, properties that are ill-suited for charter schools. Also, since charter schools tend to rent or use donated space as little funding is available to build new structures, the availability of existing building space is particularly important. Since these characteristics are unlikely to

[14]Schools' 2008 addresses were matched, when possible, to property records available from 1995-2001. If schools could not be matched then a visual inspection was done using Google Street View™. One charter in LUSD's boundaries could not be matched via property records or visually to a building type.

be correlated with other factors that could influence student outcomes, I argue that they serve as plausibly exogenous instruments for charter share. I will also provide evidence that the results are robust to tests of instrument validity.

My data on building supply comes from the county tax appraisal office and is based on their 1995 tax records. I use the year 1995 to address the concern that building supply could be correlated with local economic trends. Since 1995 is prior to the opening of charters in LUSD-SW, I avoid concurrent changes in building supply and charter share as local economic conditions vary over time. For the buildings space variable, I use properties with between 20,000 and 50,000 square feet of building space as this closely corresponds to the 25th to 75th percentile of building space for charter schools whose current address I could match to property records.[15] The average building space for properties housing charters is 52,745 s.f. and the median is 32,942 s.f. My second instrument is the number of shopping centers within a specified distance radius.[16][17] One concern regarding these instruments is that they are time-invariant and pre-existing and thus may only provide local average treatment effects for early charters for which they will have a stronger effect. To address this, I interact both of the instruments with the average charter share across LUSD in each year, thus ensuring that the instruments increase as overall charter penetration increases.[18]

The first and second stages of the baseline 2SLS model can hence be expressed as

$$\tilde{C}^d_{jt} = \delta_1 \widetilde{Buildings}^d_{jt} + \delta_2 \widetilde{ShoppingCenters}^d_{jt} + \tilde{\mathbf{X}}_{ijt}\Omega + \tilde{\mathbf{G}}_{it}\Theta + \tilde{\nu}_{ijt}. \tag{7}$$

$$\tilde{y}_{ijt} = \beta \widehat{\tilde{C}}^d_{jt} + \tilde{\mathbf{X}}_{ijt}\Omega + \tilde{\mathbf{G}}_{it}\Theta + \tilde{\nu}_{ijt}. \tag{8}$$

where $\widetilde{Buildings}^d_{jt}$ and $\widetilde{ShoppingCenters}^d_{jt}$ are the instruments described above in-

[15]The 25th percentile is 18,626 square feet and the 75th percentile is 49,450 square feet

[16] I use the number of properties rather than percentage since the each available property will increase the options available to a new charter and thus increase the likelihood that they will locate near the public school. A percentage measure does not capture this increase in probability as well as a count measure. Nonetheless, I conducted regressions dividing the instrument by total commercial properties within 1.5 miles in order to generate a percentage based measure of building stock and found qualitatively similar results.

[17]LUSD has the unique characteristic that it is located in a city with few zoning restrictions. Thus commercial and residential areas are often integrated and thus there are is considerable variation in the instruments across schools. For the 272 traditional public schools in operation in 2004 the average number of properties within 1.5 miles with 20,000 to 50,000 s.f. of building space is 64.5 with a 10th percentile of 16, median of 58, and a 90th percentile of 127. For shopping centers the average is 21.2 with a 10th percentile of 5, median of 16, and a 90th percentile of 46.

[18]Average charter share is an unweighted average at the school level. Before interacting I normalize the average charter share to equal one in 2004-05

teracted with average charter share and then demeaned within individuals.

Table 3 shows the first-stage results for the 2SLS estimates. In both samples the instruments are statistically significant at the 5% level. The joint F-test shows the instruments to be reasonably strong with an F-statistic of 16.2 for the test-score gain regressions and 14.5 for the discipline and attendance regressions.

Defining Charter Penetration

In order to assess the impact of charter schools on non-charter students, one needs to identify which charters are geographically close enough to affect the traditional public school. The extent of concentration of charters nearby can be referred to as "charter penetration." Early measures of charter penetration were similar to that proposed by Hoxby (2001). Her measure was whether a school district has over 6% of enrollment in charter schools. But this does not inform us about school level penetration, nor does it necessarily apply to locations other than Michigan where her analysis had been conducted.

There are two issues to consider when measuring charter penetration at the school level. The first is, for a given geographic area, what is the proper measure of charter penetration? Previous work has used the number of charters near a traditional public school and the share of total enrollment in charter schools (Booker et al. 2008, Bifulco and Ladd 2006, Sass 2006, Holmes, DeSimone and Rupp 2003). I use a modification of the second measure which uses enrollment only in the grades covered by the regular public school. I believe this measurement best reflects the pressures that non-charter schools face from charter schools. Thus, I define charter penetration as follows. Define a set of schools within a distance (d) of school j, including j as $J = 1, 2, ..., N_T^d, N_T^d + 1, N_T^d + 2, ..., N_T^d + N_C^d$ where N_T^d is the total number of traditional public schools and N_C^d is the total number of charter schools. Charter penetration is calculated as

$$ChartPen_{jt}^d = \frac{\sum_{g=Gmin_j}^{Gmax_j} \sum_{l=N_T^d+1}^{N_C^d} Enroll_{glt}}{\sum_{g=Gmin_j}^{Gmax_j} \sum_{l=1}^{N_C^d} Enroll_{glt}} \quad (9)$$

where $Gmin$ and $Gmax$ are the lowest and highest grades, respectively for school j and $Enroll_{gnt}$ is enrollment in grade g, school l and year t. For example, suppose I am measuring charter penetration within one mile of a school, j, that serves grades kindergarten through five. In this case, for the denominator I calculate the total number of students attending schools within one mile (including those in j) who are in grades kindergarten through five. For the numerator, I do the same calculation, but limit only to state charter schools. Thus, my charter penetration measure is the fraction of all public school and charter school students in overlapping grades who attend a state charter school within a geographic radius around the public school.[19]

The second issue is how wide of a geographic area defines a school's "market area" within which it is subject to competitive pressures from charters. A necessary condition for this pressure to exist is that there is the potential for charters to draw students away from regular public schools. While I cannot directly test this potential, I can investigate whether increases in charter enrollment are associated with reductions in enrollment in nearby regular public schools. Table 4 shows results that try to answer this question by running regressions of the form

$$Enroll_{jt} = \alpha + \beta ChartEnroll^{d}_{jt} + \mathbf{X_{jt}}\mathbf{\Psi} + \epsilon_{jt} \tag{10}$$

where $Enroll_{jt}$ is enrollment in a regular public school j at time t, $ChartEnroll^{d}_{jt}$ is total enrollment in state charter schools within d miles of the regular public school and X includes year effects and/or school fixed-effects depending on the specification. When school and year fixed effects are added, a clear pattern emerges. The results suggest that an increase in charter enrollment within one mile of 100 students is associated with a loss of twelve students from the local public school. As expected, this number drops when we look at one to two miles, but remains statistically significant at seven students per 100 charter seats. However, for charters opening between two and three miles, there is no statistically significant relationship with regular public school enrollment.[20] This suggests that in LUSD, any regular public school would likely only be affected by charters which open within two miles of their boundaries. Thus, for the purposes of this paper, I focus my attention on schools where charters open within relatively short distances. In particular I use 1.5 miles from the regular public schools as distance measures. Baseline estimates using a one mile and a two-mile radius were similar to the 1.5 mile estimates and are available in appendix table 2.[21]

[19] I exclude from this measure five residential treatment facilities for substance abusers or juvenile detention centers since enrollment in these is not voluntary. I also exclude one internet based charter and one school that helps adults with credit repair.

[20] Regressions using years 1993 - 2004 and 1998 - 2004 provide qualitatively similar results

[21] Previous papers which look at charter impacts on non-charter schools use considerably varying distances. Bifulco and Ladd (2006) and Sass (2006) use 2.5, 5, and 10 miles, while Holmes, Desimone, and Rupp (2003) use distances ranging from 5 to 20 kilometers (3.1 to 12.4 miles) and also use the county as the local education market. These longer distances are more appropriate in the context of

6 Results

Test Scores

Table 5 provides the main set of estimates for this paper. All regressions include student fixed-effects. In addition, the regressions also control for free lunch eligibility, reduced price lunch eligibility, whether the student has another economic disadvantage, whether the student is a recent immigrant, whether the student's parents are migrant workers, and grade-by-year indicator variables.[22] The estimates shown here can be interpreted as a ten percentage point increase in charter share changing outcomes by the coefficient divided by ten.

Panel A shows the estimates for Stanford 9/10 gains. In column (1) I provide OLS estimates without school fixed-effects. All three exam subjects - math, reading, and language - show no statistically significant effect of charter penetration. Column (2) adds school dummies to account for school fixed-effects. This is the type of model that has been commonly used in the previous literature. As such, the results are broadly consistent with what has been found in those papers. For reading there is a small but statistically significant increase in test-score gains of 0.02 standard deviations for a 10 percentage point increase in charter share. Math and language estimates have similar magnitudes but math is statistically insignificant and language is only statistically significant at the 10% level.

Column (3) provides the key results for this paper. In this column I provide estimates from two-stage least squares regressions that utilize the number of properties within 1.5 miles of at traditional public school that have 20,000 to 50,000 s.f. of building space and the number of shopping centers within 1.5 miles as instruments for charter share.[23] In this model the results change considerably from the fixed-effects estimates. Both math and language scores show statistically significant drops in test-score gains. For math, the drop is 0.07 standard deviations for a 10 percentage point increase in charter share while for language it's 0.06 standard deviations. The impact on reading scores is essentially zero. This means that if a school increases from no charter penetration within 1.5 miles to the 2004 average of 4% then math and language gains will drop by 0.03 and 0.02 standard deviations, respectively. This is a relatively modest drop, but nonetheless differs substantially from the positive

these papers, since their data include many suburban and rural areas where school attendance zones are larger. However, my results do suggest that the proper distance should vary with urbanicity.

[22]See appendix table 1 for definitions of these variables.

[23]All 2SLS regressions in table 5 pass a Sargon-Hansen over-identification test at all standard levels of significance.

estimate garnered from the regressions with school fixed effects. Thus, overall, the instrumental variable estimates suggest that charter schools have a modest negative impact on test score gains in regular public schools.

Behavior

In panel B of table 5 we turn our attention to discipline and attendance impacts. The discipline measure I use is the number of times a student is given an in-school suspension or more severe punishment over the course of the year. These two measures are important potential indicators of non-cognitive skill formation. A potential problem, however, is that disciplinary infractions is a measure of both outcomes and enforcement. Thus, Imberman (2008) argues that while impacts on disciplinary infractions alone may not indicate improved behavior, if it is concurrent with improvements in attendance than we can interpret the results as improvements in behavior due to non-cognitive skill formation.

In OLS estimates with student fixed-effects but no school fixed-effects show essentially no impact on disciplinary infractions and a significant drop in attendance rates. When we add school fixed effects in column (2) both estimates increase and are statistically insignificant. In column (3) the two-stage least squares estimates show a significant improvement in discipline. A 10 percentage point increase in charter share reduces disciplinary infractions by 0.45 per student. While this may seem particularly large, later on we will see that the impact is almost all in middle and high school grades where average number of infractions is considerably higher than the district overall. Nonetheless there is no corresponding improvement in attendance. Estimates for attendance rates are close to zero and statistically insignificant. Thus, since the attendance rate does not improve along with the disciplinary infractions, it is possible that the discipline improvement is purely a change in enforcement.

Specification Checks

In table 6, I provide some specification checks to test potential concerns with the 2SLS results. One concern is that the shopping centers instrument is driving the estimates. This variable is more likely to be correlated with economic conditions then the building size variable and also likely influences fewer charter school decisions, thus pinpointing much of the variation on a handful of schools. However, it is useful to include this variable as it improves the precision over using the building size instrument on its own. Thus, in column (1) I provide estimates from regressions that use only properties with 20,000 to 50,000 square feet of building space as an instrument. The results are similar to the baseline estimates with significant drops in math and language scores. The estimate on disciplinary infractions drops off somewhat but remains statistically significant at the 10% level. Despite these results, we may still be concerned that the instruments are correlated with differences in economic conditions. Thus, in column (2) I include a series of controls for characteristics of each schools' census tract as of the 2000 census. The controls include the fraction of residents who are black, Hispanic, born in another country, have a high-school degree or some college, and have a college degree. I also include the labor force participation rate for males 25 years or older and the log of average annual household income along with dummy variables for which of LUSD's six regional districts - north, south, central, east, west, and alternative - that the school is in. These estimates are nearly unchanged from the main estimates in table 5. In column (3) II address the possibility that the instruments may be picking up the effects of urbanization. To check this, I control for a quadratic in the total number of commercial properties within 1.5 miles. Almost all properties with 20,000 - 50,000 square feet of building space are commercial. While the estimates shift towards zero, math and discipline are still statistically significant at the 5% and 1% levels, respectively, and language is significant at the 10% level. Reading and attendance remain statistically insignificant. Thus, the 2SLS estimates are robust to the specification checks.

6.1 Heterogeneity by Grade, Race, and Gender

In table 7, I look at what happens to the test score estimates when the sample is split by grade, gender and race. Columns (1) and (2) consider how the estimates vary by grade. Most of the impacts seem to occur in older children. In column (1) I provide results for elementary students (grades 1 - 5). The test score estimates are imprecise but they do show an impact that ranges from zero to negative. Reading is the most hard hit subject at -0.08 standard deviations for a 10 percentage point increase in charter share, however it is only significant at the 10% level. Discipline and attendance for elementary students also seems to be generally unaffected. For middle and high-school students, shown in column (2) I find drops in math and language scores, where math is significant at the 10% level and language at the 5% level. At the same time, however, discipline improves substantially amongst middle and high students. The estimate of -5.8 implies that going from no charter penetration to the 2004-05 average of 4% reduces disciplinary infractions by 0.2 per student. This is approximately 30% of the average infraction rate amongst these grades. Columns (3) and (4) look at differences by gender. Both boys and girls have reductions in disciplinary infractions and drops in test-score gains. However, girls have larger drops in test scores than boys. The impact on math gains for girls is statistically significant and indicates a 0.14 standard deviation drop for a 10 percentage point increase in charter share. Boys show no statistically significant impact. For language, however, both genders show statistically significant drops in gains, but the reduction for girls is somewhat larger at 0.08 standard deviations for every 10 percentage point increase in charter share while for boys the drop is 0.05 standard deviations.

Finally, in columns (5) - (7) I separate the sample by race. Blacks appear to fare poorly on test scores as they suffer drops of 0.10 standard deviations and 0.14 standard deviations for math and language respectively with a 10 percentage point increase in charter share. However, their disciplinary infractions also drop more than hispanics or whites. For Hispanics the results are mixed. While there is a statistically significant drop in math gains, there is also a statistically significant improvement for reading as well as a drop in disciplinary infractions. For whites, the sample sizes are smaller so the estimates are generally too imprecise to draw clear conclusions.

7 Conclusion

Charter schools have the potential to generate strong incentives for public school administrators and teachers to increase effort and improve student performance. In particular, charter advocates argue that traditional public schools will work harder to prevent students from leaving so as to avoid losing funding and enrollment. In addition, charters could also improve student outcomes by serving as "release valves" for overcrowded schools or by changing peer composition. On the other hand, charters could also lead to worsening student outcomes if traditional public schools cannot adjust easily to funding losses, charters change peer groups in a negative way, or charters hire good teachers from the public schools.

Using data from a large urban school district in the southwest (LUSD-SW) I analyze how charter schools affect students in traditional public schools using an instrumental variables strategy to address potentially endogenous charter location and student fixed-effects to address endogenous movement of students across schools. My instruments utilize constraints on charter location choices determined by the availability of appropriate locations to house a school. I argue that charters in LUSD need to locate in properties that have enough building space house the school. However, properties that are very large are generally undesirable locations for charters such as office buildings, warehouses and apartment complexes. Thus, I utilize as an instrument the number of properties with 20,000 to 50,000 square feet of building space within 1.5 miles, which closely corresponds to the inter-quartile range of building space for properties housing charters in LUSD in 2004. In addition, 16% of charters in LUSD as of 2004 locate in current or former shopping centers. These structures are often ideal locations for charters since they are easy to rent, are usually on main roads, and provide space that can easily be modified. Thus I also use as an instrument, the number of shopping centers within 1.5 miles of a regular public school. Both of these instruments are interacted with average charter share, which is the share of students in overlapping grades within 1.5 miles of a traditional public school who attend charters, for the district in each year in order to add temporal variation.

I find evidence that charter schools have a deleterious impact on math and language test score gains in traditional public schools. Average math score gains fall by 0.07 standard deviations for a 10 percentage point increase in charter share , while language gains fall by 0.06 standard deviations. Reading scores appear to be unaffected by charter penetration on average. These results differ from the previous literature which generally finds either positive or statistically insignificant impacts of charter penetration on regular public schools. Indeed, I conduct analyses using school-fixed effects and find results for LUSD that are consistent with the prior literature.

While I cannot be sure what mechanisms drive these results, as the analysis is reduced-form in nature, there are a few possibilities. One is that the schools lose substantial funding in LUSD from a loss of a student to a charter that they are not able to recover from in the short-term. These losses can be substantial. For LUSD prior to 2002, if a student with no special categories leaves the district they lose revenue equal to 67% of average expenditures per-student. After 2002 this is reduced to 46% which is still a large amount. A second possibility is that charters change the peers students face in the non-charter schools by attracting specific types of students. Since I do not have individual data on the state charter schools I cannot be sure to what extent the students differ. However, summary statistics using school level data suggest that charters attract students who are socio-economically better off than non-charter students on average, although they have lower test scores. A third possibility may be that charters attract high-quality teachers from the regular public schools and the need to cut costs, potentially through reducing staff, can impact teacher morale.

In addition to test scores, I look at disciplinary infractions - measured by the number of in-school suspensions or more severe punishments a student incurs over the course of an academic year - and attendance rates. Imberman (2008) argues, based on evidence from Heckman, Stixrud and Urzua (2006) that these measures together can serve as a proxy for non-cognitive skill formation while test scores measure cognitive skill formation. However, because discipline is a measure of both behavior and enforcement, any impacts in this measure need to also show up in attendance to have confidence that there are real behavioral changes. I find that there are statistically significant drops in disciplinary infractions of 0.45 instances per student with an increase in charter share of 10 percentage points. However, I find no evidence of improvement for attendance. Thus, the large improvement in discipline combined with the drop in test scores and lack of improvement in attendance suggest that a likely explanation is that the discipline results are due to changes in enforcement in response to charter competition, though real behavioral improvements cannot be ruled out.

When interpreting these estimates, though, one must realize the limitations of this analysis. First of all, since I am looking within a single, albeit very large, school district, the treatment effects are for highly localized insertions of charter schools. Thus, this analysis does not consider what happens to the district overall as charter programs grow. In fact, one could potentially have a situation where while charters may be detrimental to individual schools close by, they could improve outcomes in a school district as a whole. Second, LUSD is somewhat unique in the sense that there already exist substantial choice options for students. The district has a wide range of magnet programs and it's own charter program. There is also a large number of private schools in LUSD. Hence, whereas the marginal benefit from additional choice in LUSD may be small, it could be substantially larger in other urban school districts. Finally, due to the limitations of my instruments, I only consider short-term impacts of charters and thus, over the long-term, charters could be more beneficial.

Nonetheless, these results do show that charters can generate detrimental impacts in regular public schools. Thus it is important for policy makers and researchers to watch charter programs so that we can determine whether they're having the desired effect on regular public schools and to modify such programs if the impacts become undesirable.

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Figure 1 - Charter Schools in LUSD Area

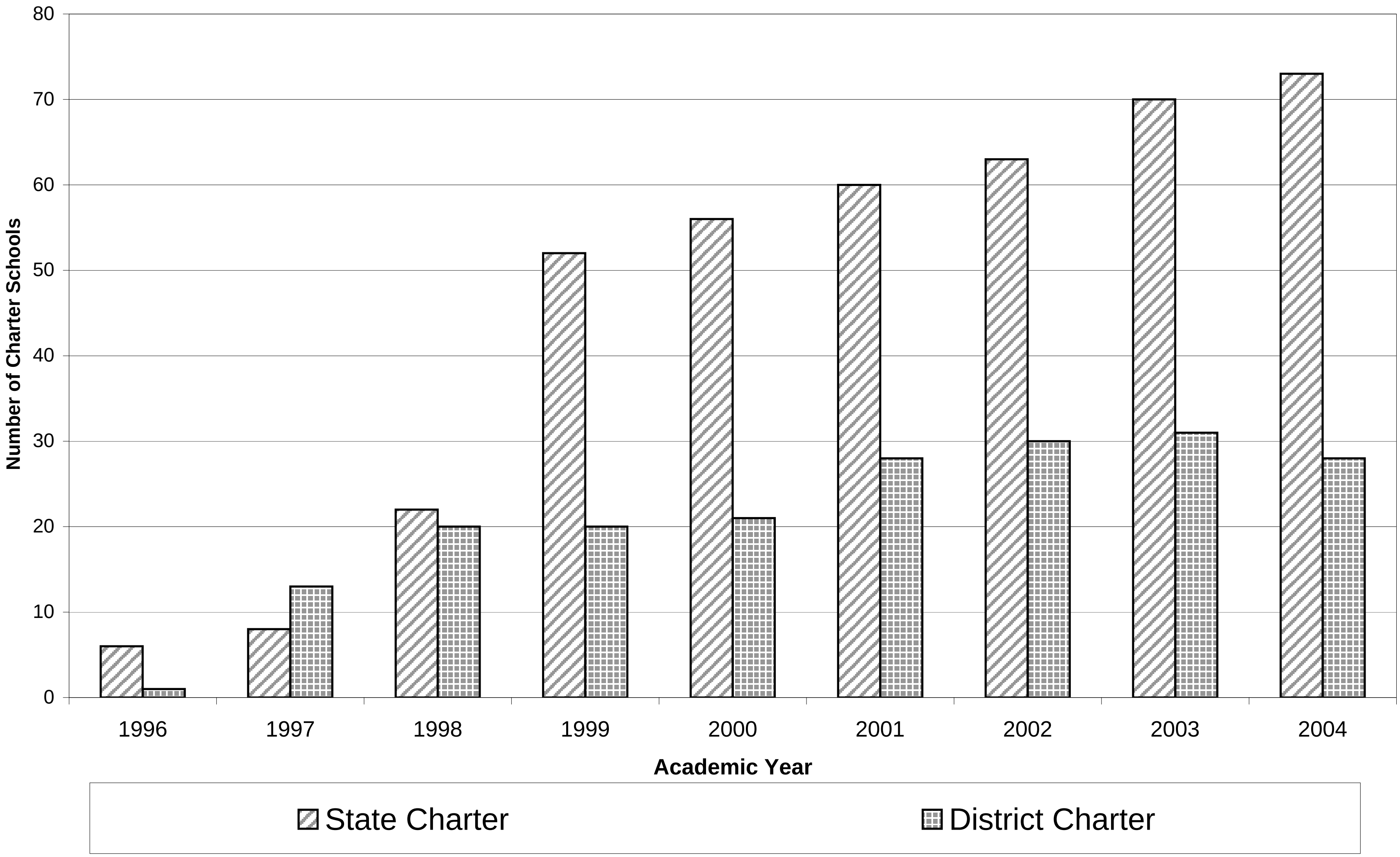
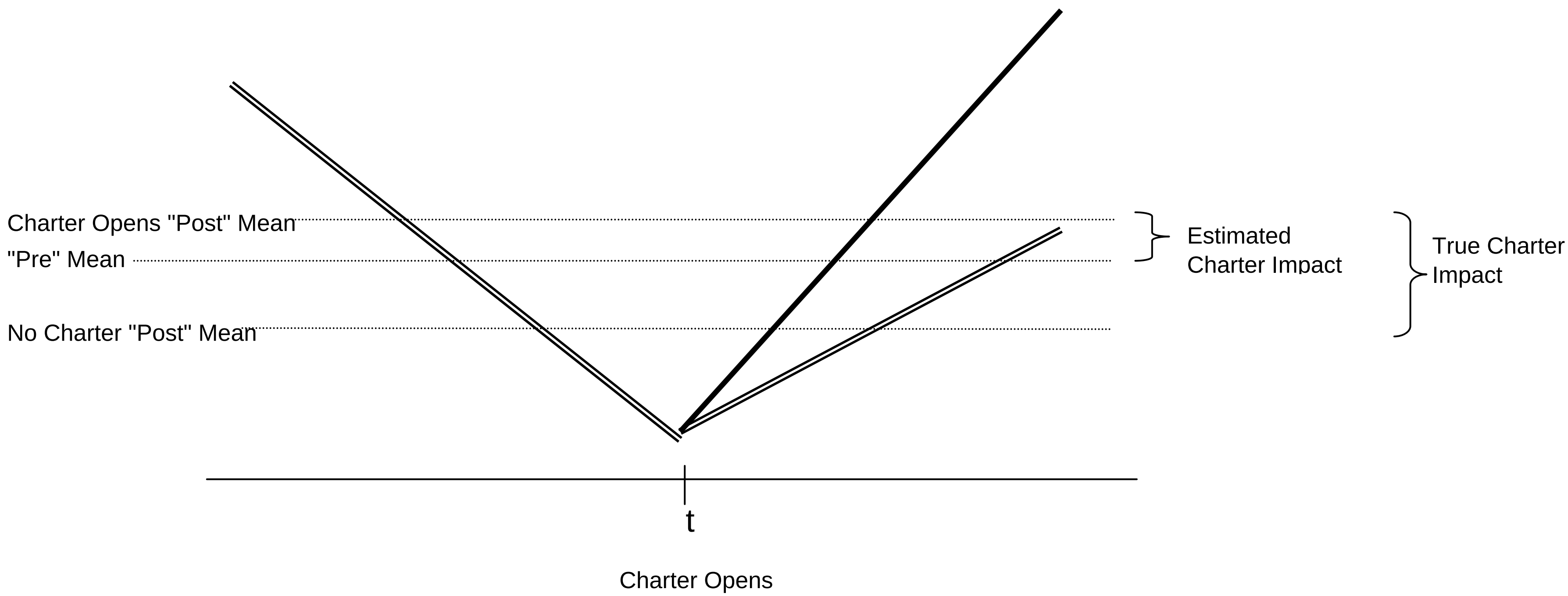
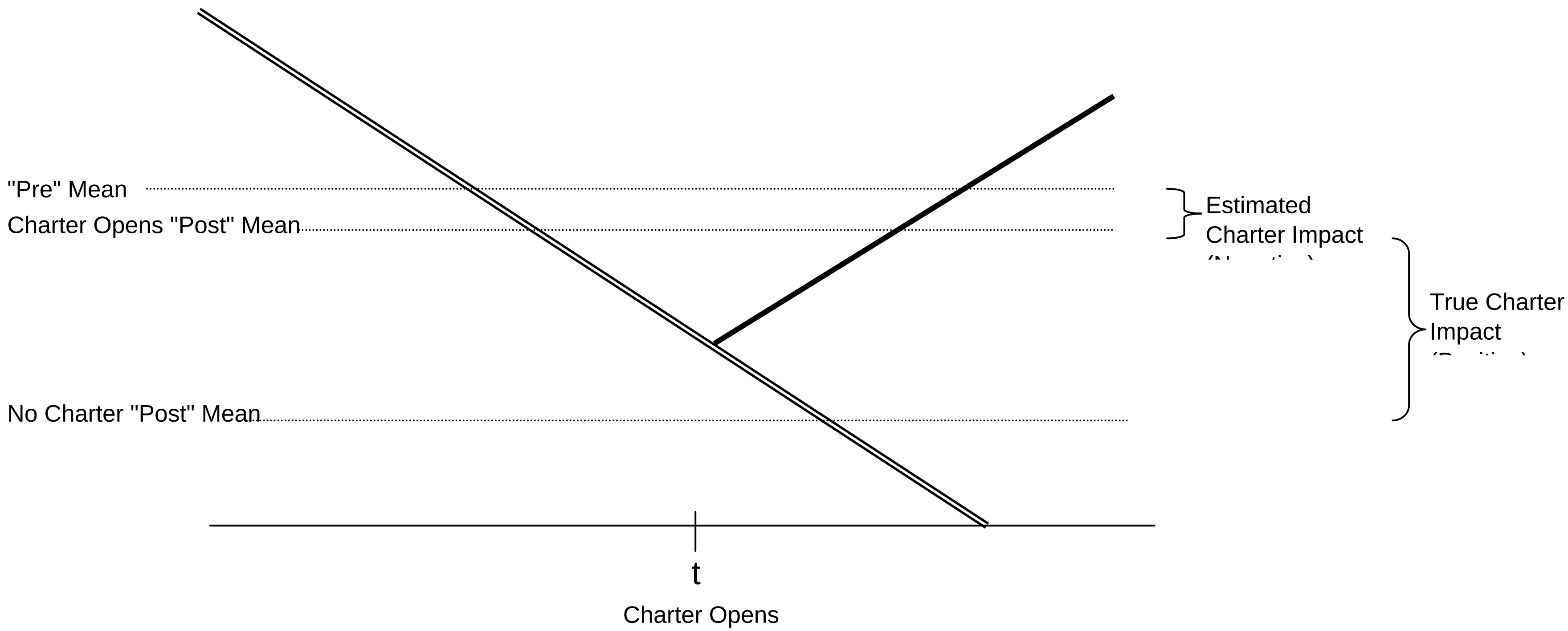


Figure 3A - Bias of School Fixed-Effects from Selection Of Charter Location Based on Temporary Trends



The single solid line shows what happens to the outcome after the charter opens after removing school fixed effect. The double solid line is the outcome path taken had no charter opened.

Figure 3B- Bias of School Fixed-Effects from Selection Of Charter Location Based on Permanent Trends



The single solid line shows what happens to the outcome after the charter opens after removing school fixed effect. The double solid line is the outcome path taken had no charter opened.

Table 1 - Charter and Non-Charter Student Characteristics, 1998 - 2004

	LUSD-SW Traditional Schools	State Charters
Economically disadvantaged†	77.9 (24.4)	65.4** (27.4)
Limited English proficient	27.9 (22.5)	10.0** (21.0)
Special education	10.3 (6.1)	6.6** (7.6)
Gifted	9.5 (12.8)	2.0** (6.0)
White, non-Hispanic	9.7 (15.2)	6.7* (16.9)
African-American, non-Hispanic	56.3 (30.9)	37.0** (35.8)
Hispanic	30.9 (29.4)	55.0** (38.2)
Observations	1928	358
% Passing State Exams at 2004 Level (2002 - 2004 only)	44.9 (20.1)	36.4** (24.5)
Observations	784	156

† A student is economically disadvantaged if he or she satistfies one of the following conditions: (1) is eligible to receive free or reduced price lunch, (2) has family income at or below the Federal poverty line, (3) is eligible for TANF or other public assistance, (4) is eligible for programs under Title II of the Job-Training Partnership Act, (5) is eligible for food stamps, or (6) receives a Federal Pell Grant.

Observations are school level aggregates in each year. Standard deviations are provided in parentheses. Results are weighted by enrollment. **, *, and # denote that a t-test of the difference in weighted means between charter and non-charter schools is significant at the 1%, 5%, and 10% levels, respectively.

Table 2A - Demographic Characteristics of LUSD Schools by Non-District Charter Penetration

Percentiles of Charter Penetration	0 - 64	65- 74	75 - 89	90 - 99
Range of Charter Penetration Rates	0.0% -1.3%	1.3% - 4.5%	4.5% - 10.8%	10.8% - 39.7%
Female	0.49 (0.09)	0.48 (0.08)	0.48 (0.05)	0.49 (0.07)
White, non-Hispanic	0.09 (0.15)	0.06 (0.12)	0.06* (0.13)	0.10 (0.16)
African American, non-Hispanic	0.37 (0.32)	0.33 (0.33)	0.36 (0.30)	0.36 (0.29)
Hispanic	0.52 (0.32)	0.59 (0.33)	0.56 (0.30)	0.51 (0.30)
Free Lunch Eligible	0.65 (0.24)	0.71* (0.23)	0.73*** (0.22)	0.62 (0.26)
Reduced-Price Lunch Eligible	0.08 (0.04)	0.08 (0.04)	0.08 (0.04)	0.08 (0.04)
At Risk	0.58 (0.20)	0.61* (0.17)	0.66*** (0.18)	0.64* (0.23)
Limited English Proficient	0.25 (0.21)	0.28 (0.21)	0.33*** (0.25)	0.30 (0.27)
Special Education	0.10 (0.14)	0.06*** (0.10)	0.07** (0.09)	0.12 (0.20)
Gifted & Talented	0.12 (0.10)	0.11 (0.09)	0.11 (0.09)	0.12 (0.13)
Immigrant	0.11 (0.08)	0.12 (0.09)	0.14** (0.10)	0.15** (0.14)
Observations	1131	282	282	188

Charter penetration is defined the fraction of students who attend schools within 1.5 miles of and are in grades covered by the school being observed who attend state charters. Standard deviations shown in parentheses. **, *, and # denote that the mean is stastistically significantly different from column one using standard errors clustered by school at the 1%, 5%, and 10% levels, respectively. Covers 1998 - 2004 only, so that only years with a large number of charter schools are considered. Each observation is the school-year mean.

Table 2B - Outcomes for LUSD Schools by Non-District Charter Penetration

Percentiles of Charter Penetration	0 - 64	65- 74	75 - 89	90 - 99
Range of Charter Penetration Rates	0.0% -1.3%	1.3% - 4.5%	4.5% - 10.8%	10.8% - 39.7%
Stanford 9/10 - Math	-0.07	-0.12	-0.13	-0.07
	(0.46)	(0.41)	(0.36)	(0.47)
Stanford 9/10 - Reading	-0.07	-0.16	-0.16*	-0.08
	(0.48)	(0.44)	(0.37)	(0.50)
Stanford 9/10 - Language	-0.07	-0.15	-0.16*	-0.09
	(0.47)	(0.42)	(0.36)	(0.49)
# of Disciplinary Infractions	0.36	0.30	0.33	0.39
	(0.59)	(0.51)	(0.53)	(0.55)
Attendance Rate (%)	94.37	94.87	94.84	93.37
	(5.85)	(5.23)	(4.79)	(6.87)
Observations	1131	282	282	188

Charter penetration is defined the fraction of students who attend schools within 1.5 miles of and are in grades covered by the school being observed who attend state charters. Standard deviations shown in parentheses. All test scores are measured as standard deviations from the mean scale score. **, *, and # denote that the mean is stastistically significantly different from column one using standard errors clustered by school at the 1%, 5%, and 10% levels, respectively. Covers 1998 - 2004 only, so that only years with a large number of charter schools are considered. Each observation is the school-year mean.

Table 3 - 2SLS First Stage Estimates

Endogenous Variable	(average charter share)* (# properties with 20k - 50k s.f. of building space in 1995)	(average charter share)* (# of shopping centers or strip malls in 1995)	F-Test of joint significance of excluded instruments
		I. Test Score Gain Regressions	
Charter Share in Overlapping Grades within 1.5 Miles	0.00028*** (0.00009)	0.00063** (0.00025)	16.2
		II. Discipline & Attendance Regressions	
Charter Share in Overlapping Grades within 1.5 Miles	0.00020** (0.00010)	0.00086*** (0.00026)	14.5

Charter penetration measure is share of enrollment in overlapping grades within specified distance. Test score regressions have 583,091 observations covering grades 2 - 11 in 1999 - 2004. Discipline & attendance regressions have 2,049,076 observations covering grades 1 - 12 in 1993 - 2004. All regressions are demeaned within individuals to remove student fixed effects and include free or reduced price lunch status, other economic disadvantages, parents' migrant status, and grade*year dummies as covariates. Huber/White standard errors clustered by school in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Relationship Between Charter Penetration and School Enrollment (1996 - 2004)

State Charter Enrollment Within	(1)	(2)	(3)
0 - 1 Mile	0.051	0.058	-0.123**
	(0.123)	(0.133)	(0.052)
1 - 2 Miles	0.135	0.152	-0.067**
	(0.098)	(0.111)	(0.033)
2 - 3 Miles	0.146	0.169	-0.008
	(0.091)	(0.105)	(0.022)
Observations	2484	2484	2484
Year Fixed Effects	N	Y	Y
School Fixed Effects	N	N	Y

Dependent variable is total school enrollment. Observations are school-year aggregates. Regressions contain no covariates except those specified. Robust standard errors clustered by school are in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Estimates of Charter School Impacts on Traditonal Public School Students

	(1) OLS	(2) OLS	(3) 2SLS
	A. Stanford 9/10 Gains (standard deviation units)		
Math	0.087 (0.063)	0.169 (0.120)	-0.706** (0.301)
Reading	0.038 (0.043)	0.172** (0.081)	0.019 (0.160)
Language	0.057 (0.044)	0.156* (0.082)	-0.599*** (0.203)
Observations	583,091	583,091	583,091
	B. Behavior Measures		
# Disciplinary Infractions	0.010 (0.363)	0.316 (0.320)	-4.508*** (1.160)
Attendance	-2.426** (1.168)	-0.564 (0.580)	-0.332 (6.417)
Observations	2,049,076	2,049,076	2,049,076
Student Fixed Effects	Y	Y	Y
School Fixed Effects	N	Y	N

Charter penetration measure is share of enrollment in overlapping grades within 1.5 miles All regressions include free or reduced price lunch status, other economic disadvantages, recent immigration status, parents' migrant status, and grade*year dummies as covariates. Each regression is also demeaned within individuals to remove student fixed-effects. Huber/White standard errors clustered by school in parentheses. **, *, and # denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Specification Checks

	(1) 2SLS - Only Building Space Instrument	(2) 2SLS - City Region & Economic Controls	(3) 2SLS - Control for # of Commercial Properties
	A. Stanford 9/10 Gains (standard deviation units)		
Math	-0.819**	-0.773**	-0.539**
	(0.355)	(0.347)	(0.272)
Reading	-0.085	-0.054	0.202
	(0.192)	(0.207)	(0.181)
Language	-0.682***	-0.634**	-0.309*
	(0.240)	(0.258)	(0.181)
Observations	583,091	583,091	583,091
	B. Behavior Measures		
# Disciplinary Infractions	-2.994*	-4.631***	-4.411***
	(1.770)	(1.228)	(1.193)
Attendance	-6.592	4.777	-1.100
	(7.456)	(7.495)	(7.000)
Observations	2,049,076	2,049,076	2,049,076

Charter penetration measure is share of enrollment in overlapping grades within 1.5 miles All regressions include free or reduced price lunch status, other economic disadvantages, recent immigration status, parents' migrant status, and grade*year dummies as covariates. Each regression is also demeaned within individuals to remove student fixed-effects.   Huber/White standard errors clustered by school in parentheses. **, *, and # denote significance at the 1%, 5%, and 10% levels, respectively.

Table 7: 2SLS Estimates of Charter School Impacts on Traditonal Public School Students - By Grade, Race & Gender

	Grade Level		Gender		Race		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Elementary	Milddle/High	Boys	Girls	Black	Hispanic	White
A. Stanford 9/10 Gains (standard deviation units)							
Math	0.013	-0.579*	-0.392	-1.429***	-0.987**	-0.694**	-1.633
	(0.566)	(0.333)	(0.291)	(0.515)	(0.500)	(0.323)	(1.133)
Reading	-0.775*	-0.013	0.281	-0.373	-0.446	0.516**	-0.343
	(0.456)	(0.191)	(0.253)	(0.272)	(0.352)	(0.250)	(0.740)
Language	-0.286	-0.469**	-0.511**	-0.823**	-1.426***	-0.034	0.302
	(0.550)	(0.199)	(0.242)	(0.330)	(0.436)	(0.178)	(0.736)
Observations	234,492	348,665	292,024	291,067	210,301	285,108	66,770
B. Behavior Measures							
# Disciplinary Infractions	0.330	-5.797***	-6.178***	-4.855***	-7.099**	-3.701***	-2.054
	(0.622)	(1.533)	(1.861)	(1.441)	(3.257)	(1.346)	(1.788)
Attendance	-5.647	1.610	3.858	-2.981	4.430	3.431	9.200
	(3.590)	(8.531)	(9.814)	(9.497)	(16.323)	(7.614)	(15.099)
Observations	1,003,075	1,046,001	1,041,310	1,007,766	679,650	1,089,537	219,191

Charter penetration measure is share of enrollment in overlapping grades within 1.5 miles Elementary includes all students in grades 1 - 5 and middle\high includes all students in grades 6 - 12. All regressions include free or reduced price lunch status, other economic disadvantages, recent immigration status, parents' migrant status, and grade*year dummies as covariates. Each regression is also demeaned within individuals to remove student fixed-effects. Huber/White standard errors clustered by school in parentheses. **, *, and # denote significance at the 1%, 5%, and 10% levels, respectively.

Table A1 - Description of Data Elements Used in Analysis

Student Level Variables	Definition
At risk	At risk classification varies by grade: K - 3: Student fails a state reading exam or is LEP. 4 - 12: Student fails any section of state exam on most recent attempt, is LEP, or is overrage for grade. A student is also classified "at-risk" if he/she is pregnant, abused, a parent, homeless, has previously dropped out, resides in a residential placement facility, attends an alternative education program, is
Attendance rate	Percent of days the student is enrolled during which the student attends class.
Free lunch	Whether student is eligible for free lunches under the Federal free-lunch program.
Gifted and talented	Student is enrolled in a gifted and talented program.
Infractions	Number of disciplinary infractions a student has during a given year warranting a punishment of one day suspension or higher.
Limited English proficient (LEP)	A student is categorized as LEP if (a) he or she speaks a language other than english at home and (b) scores below English proficiency level on a oral language proficiency test or scores below the 40th percentile in total reading and language on standardized tests
Other economic disadvantage	Student is designated as having another economic disadvantage if the student does not qualify for free or reduced-price luncha and one of the following conditions hold: (1) family income is below Federal poverty line (2) is eligible for public assistance (i.e. TANF, Food Stamps, etc.) (3) family received a Pell Grant or comparable form of state financial aid (4) eligible for training under Title II of the Job Training Partnership Act
Parents are migrants	Student meets the following conditions for eligibility for the Migrant Education Program (MEP): (1) aged 3 - 21 (2) has a parent, guardian, or spouse who is a migratory agricultural or fishing worker (3) has moved between school districts withing 3 years for said parent, guardian, or spouse to seek temporary or seasonal work in agriculature or fishing
Recent immigrant (within 3 years)	Student is aged 3 - 21, was born outside the US, and has not been enrolled in a US school for more than 3 years (based on eligibility requirements of the Emergency Immigrant Education Program (EIEP) of 1994.
Reduced price lunch	Whether student is eligible for reduced price lunches under the Federal free-lunch program.
Special education	Student is eligible for special education services.
Stanford 9/10 Math, Reading, and Language	Score on Stanford Achievement Test vertsions 9 and 10 in math, reading or language Measured in standard deviations of scale scores.

Census Tract Variables	Definition
Population Density	Population count of Census tract divided by land area of tract. In miles.
Fraction Black	Fraction of people in Census tract who are black.
Fraction Hispanic	Fraction of people in Census tract who are Hispanic.
Fraction Non-Native	Fraction of people in Census tract who were not born in the United States.
Fraction w/ HS or Some College	Fraction of people in Census tract who graduated high school but did not complete a 4-year college degree.
Fraction w/ College or Advanced Degree	Fraction of people in Census tract who completed a 4-year college degree.
Labor Force Participation	Fraction of males aged 16+ in Census tract who are in the labor force.
Ln (Household Income)	Natural logarithm of median household income in Census tract.
Fraction receiving Public Assistance	Fraction of people in Census tract who receive money from a Federal, state, or local anti-poverty program.

Appendix Table 2: 2SLS Estimates of Charter Share on Traditonal Public School Students - 1 and 2 Mile Radii

	(1) 1 Mile Radius	(2) 2 Mile Radius
A. Stanford 9/10 Gains (standard deviation units)		
Math	-0.867**	-0.587*
	(0.361)	(0.309)
Reading	-0.015	0.045
	(0.214)	(0.159)
Language	-0.648***	-0.445**
	0.057	(0.220)
Observations	583,091	583,091
B. Behavior Measures		
# Disciplinary Infractions	-5.666***	-3.651***
	(1.661)	(1.384)
Attendance	0.623	0.882
	(9.488)	(5.718)
Observations	2,049,076	2,049,076

Charter penetration measure is share of enrollment in overlapping grades within 1.5 miles All regressions include free or reduced price lunch status, other economic disadvantages, recent immigration status, parents' migrant status, and grade*year dummies as covariates. Each regression is also demeaned within individuals to remove student fixed-effects. Huber/White standard errors clustered by school in parentheses. **, *, and # denote significance at the 1%, 5%, and 10% levels, respectively.