The Effect of Charter Schools on Traditional Public School Students in Texas: Are Children Who Stay Behind Left Behind?

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Abstract

Texas has been an important player in the emergence of the charter school industry. We test for a competitive effect of charters by looking for changes in student achievement in traditional public schools following charter market penetration. We use an eight-year panel of data on individual student test scores for public schools students in Texas in order to evaluate the achievement impact of charter schools. We control for student background in two ways. We estimate a model which includes campus fixed effects to control for campus demographic and peer group characteristics, and student fixed effects to control directly for student and student family background characteristics. We find a positive and significant effect of charter school penetration on traditional public school student outcomes.

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I. Introduction

The debate over choice reform of U.S. elementary and secondary public schools continues to rage. Against a backdrop of measured and perceived declines in the quality of public school outputs, institutional reforms which expand choice, such as vouchers, compete with within-institution reforms, such as reductions in class size, as potential performance-enhancing policies. An important claim which distinguishes choice reform from most within-institution reforms is the possibility of increasing educational outcomes for all students without increasing the allocation of resources to the educational sector. One argument for the existence of such student population outcome-improving choice policies is based upon potential inefficiency within the current public education market. In particular, existing public school suppliers may not be cost-efficient due to technical and/or allocative failures. Weak incentives could result in public schools operating above their relevant cost frontiers. A significant literature has developed which suggests that a lack of competition in the education market is an important root cause of this cost inefficiency. If choice reforms increase effective competition and all suppliers in the post-reform equilibrium move towards or onto their frontiers, then across-the-board improvements in outcomes are possible. Examples of papers which develop this theme include Hoxby (2000, 2003a, 2003b), Dee (1998), and Grosskopf et al (2004).

A second mechanism for potential system-wide improvements from expanded choice is sorting. New entrants competing within the expanded choice environment may alter the composition of the student body at a traditional public school along some relevant dimensions. For example, the ability distribution of students may be altered by the exit of some of the highest and/or lowest ability kids. The impact of compositional effects may operate through at least two channels. First, the composition of the student body may affect the instructional technique decisions of teachers. The best technique for delivering effective instruction to a classroom of students homogenous in ability may differ from that technique which works best with a heterogeneous-in-ability class. Second, the composition of the student body may directly affect achievement via peer effects. For example, adding a disruptive student to a classroom might well reduce the ability of other students to learn. Others have suggested that individual learning is affected by the mean ability of the individual's peers.[1] The direction of impact of peer effects on student achievement depends on the specific peer effect at issue, and may well be student-specific. The net effect of any compositional changes accompanying expansion of school choices on student performance is, obviously, ambiguous ex-ante, as the precise dimension of the compositional changes and the directional impact of those changes is not clear. However, to the extent that compositional effects have a positive impact on student performance, the equilibrium sort under the new institutional structure may lead to improved performance among students remaining behind at existing public schools.

The emergence of charter schools as a type of institutional reform provides an important opportunity to test the systemic effect of competition on public school students. In particular, we test whether competition from charters leads to improved scores of students remaining in traditional public schools. Because the large majority of public students remain in traditional public schools (and this is likely to remain true for the foreseeable future), the potential benefits arising from competitive effects of charter schools on traditional public schools may be of greater importance than the direct effects of charter school attendance, which have generally received more scrutiny.[2] Charter schools operate as new public sector entrants and compete directly with traditional public schools for students. Although they retain the major defining characteristics of a public school, including public sector funding, non-selective admission, and public sector monitoring, charters are given greater degrees of freedom in dealing with certain regulations.[3] The ability of charters to differentiate their product from that offered by traditional public schools while charging the same zero tuition as public schools makes charters potentially strong competitors for existing public schools in the market for students.

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[1] In a well-known study, Henderson et. al. (1977) find that students generally perform better when the mean achievement of their peer group is higher. More recently Caroline Hoxby (2001) reports that both peer group achievement levels and peer group racial and gender composition can impact student achievement.

[2] See Booker, Gilpatric, Gronberg and Jansen (2004). This paper is a significant extension of an earlier paper by Gronberg and Jansen (2001). Hanushek et. al. (2002) also investigates the outcomes for charter students in Texas.

One indicator of the success of charters as a whole is their rapid growth. This is a particularly valid indicator of charter viability because students attend charters voluntarily and with the option of returning to a traditional public school if charters prove unsatisfactory. During the 1994-95 school year there were roughly 100 charter schools enrolling 25,000 students in the United States; during the 2001-02 school year there were approximately 2,700 charter schools operating with a total enrollment of over half a million students. The Center for Education Reform (2004) reports that the number of states which had passed charter legislation grew from 20 in the 1994-95 school year to 39 plus the District of Columbia in the 2001-02 school year.

Texas has been an important player in the emergence of the charter school industry. The original charter legislation in Texas was passed in 1995. The first sixteen schools opened in the 1996-97 academic year with an enrollment of 2,412. By 2001-02, almost 47,000 students were enrolled across the 179 operating charter schools. These 47,000 students represent 1.1% of the total public school student enrollment in Texas.

In this paper we investigate the effect of charters on traditional public schools by looking for changes in student achievement outcomes in traditional public schools following charter market penetration. We utilize an eight-year panel of data on individual test scores for public school students in Texas to evaluate the achievement impact of charter schools. We control for student background in several ways. In one model we include campus fixed effects and indicators for individual student characteristics. These indicators are included to control for observed student and student family background characteristics. We also include indicators for several campus characteristics. A second model includes student fixed effects, to control directly for student and student family background characteristics. Finally, we estimate a model that includes both campus and student fixed effects. For each of these specifications we find a positive and significant effect of charter school penetration on traditional

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[3] Charter schools in Texas are exempt from teacher certification and minimum salary requirements, and have greater freedom in devising their curriculum. They remain subject to many of the programmatic requirements that fall on all

public school student outcomes. These findings support the potential for systemic achievement gains from competition-enhancing school reform policies.

II. Charter Schools in Texas

If our study of Texas charter school penetration is to provide a meaningful test of the school choice competition hypothesis, then the institutional environment must generate a viable, competitive charter sector and thus a potential traditional public school response. As argued by Hoxby (2003) in her study of charter competition in Arizona and Michigan, institutional features such as entry and funding rules will significantly impact the viability of the charter sector. The institutional structure in Texas, as discussed below, is one of the most supportive for the formation of successful charters in the country.

Since the passage of the original charter school legislation in 1995, charter schools in Texas have been expanding rapidly in both the number of charter schools and the number of students enrolled in charter schools. The expansion is at least partly attributable to the supportive charter law environment. The charter law structure in Texas is ranked as the seventh most charter-friendly in the United States by the Center for Education Reform (1997). The State Board of Education is the principal chartering agency in Texas. This granting structure facilitates greater competition between charters and traditional local public schools than in many other states in which the local public school district is also the charter-granting agent.[4]

For open enrollment charter schools in operation prior to the 2001-02 school year, the Texas school financing rules transfer one hundred percent of the maintenance and operation formula support, conditioned upon the enrollee's personal characteristics, from the child's home district to the charter

public schools, such as those regarding special education, bilingual education, and extracurricular activities.

[4] Texas charter school law allows both open enrollment charter schools, which are independent school districts, and district-chartered charter schools, which are chartered by an existing public school district and function as a part of that school district. In this paper we examine the impact of open enrollment charter schools. We do not consider charter schools chartered by existing public school districts because they do not represent a competitive threat to school districts.

school. The local district revenue implications of losing a student to a charter are thus larger in Texas than in either Michigan or Arizona, the two states which have been the focus of much of the charter school research to date. In both of those states, only the state portion of the pupil funding follows the student to the charter school.

Beginning with the 1998-99 school year an idiosyncracy in Texas charter legislation granted charters on the condition that they serve primarily (at least 75%) academically "at-risk" students, and the number of charters issued to this type of school was not capped. Other open enrollment charters were subject to legislative caps. This charter law incentive structure appears to have had an effect, as well over half of the new charter schools which opened in academic years 1998-99 and 1999-00 were of the at-risk type. This distinction between charter types and chartering rules was eliminated prior to the 2000-01 academic year.[5]

As one might expect in the early stages of charter school entry, most of the growth in students enrolled in charters was driven by the entrance of new charters, as opposed to the expansion of existing charters. As shown in Table 1, there were 16 charter schools in academic year 1996-97, the first year of charter operation. This number of charters grew more than tenfold to 179 by 2001-02. Enrollment in charters also grew rapidly, from 2,412 in 1996-97 to almost 47,000 in 2001-02. To put this in perspective, by AY 2001-02 charter schools were enrolling over 1% of the total public school student body in Texas.

Charter schools in Texas are spatially concentrated. Although there are charter schools operating in 41 of the State's 254 counties, over 60% of charters are located in counties within the five largest metropolitan areas: Houston, Dallas-Fort Worth, El Paso, San Antonio, and Austin (see Table 2). These six counties (Bexar, Dallas, El Paso, Harris, Tarrant, and Travis) contain almost 48% of the population of Texas. At the same time, there are 35 additional counties in Texas containing 65 charters, and these

[5]Open enrollment charters were initially capped at 60 students for academic year 1998-99, then 120 for 1999-00. In 2001 the legislature eliminated the at-risk exemption and capped the number of charters at 215, while also allowing for unlimited charters sponsored by colleges or universities.

counties account for over 24% of the population of Texas. Finally, there are 213 counties in Texas without a single charter school.

The concentration of charters in metropolitan areas might be expected, as charters must draw students away from existing traditional public schools and may find it easier to attract a critical mass in areas of relatively high population density. This geographic concentration also suggests that the competitive effects of charters might be strongest, or at least most easily detected, in these six counties. On the other hand, school districts in major metropolitan areas may differ from school districts in other areas of the state in ways that lead to differential responses to charter school competition.

Table 3 provides information on the extent of charter school penetration of traditional public school districts. The table provides, for each relevant academic year, the number of traditional school districts containing at least one charter school, the enrollment of the districts containing at least one charter school, and the percentage of the overall public school enrollment that is in districts containing at least one charter school. Of the 1041 school districts in Texas, the number of districts facing competition for students from at least one charter has increased from 5 in 1996-97 to 67 in 2001-02. These 67 districts, however, represent nearly 42% of the total public school enrollment in Texas.

III. Measuring Charter School Competition

A central issue in testing for the impact of charter competition is to select an appropriate measure of competition. The issue is challenging at both the conceptual and the empirical levels. There are at least three conceptual approaches to measuring the competitiveness of charters. From a pure contestability perspective, the potential for charter school entry which was created by the passage of the enabling charter school legislation is key. School districts might respond to the threat of competition without a single charter ever forming. A modified form of contestability would suggest that it is the presence of established charters that creates a meaningful competitive threat. Alternatively, charter school competition may be measured by the realized loss of students (reduced market share) to charters, rather than by the potential for such loss. Under the first approach, an empirical strategy could involve an event-type study, and competition would be measured by date of the effective establishment of charter legislation. Under the second approach, an empirical strategy could involve a production function type study, and competition would be measured by the number, spatially-adjusted, of charter schools.[6] The third approach might replace the number of firms by the percentage of students from the district who have exited to charters. This approach measures competition by the actual number of students - and accompanying dollars of funding - lost to charter schools. An advantage of this approach is that it counts not the number of charter schools regardless of size but instead counts the number of students that charters have successfully attracted away from traditional public schools. We adopt this third approach in our study.

We note that traditional public schools face other competition in the market for students. There is the traditional Tiebout competition[7] with other public schools, as well as competition from private schools[8]. These competitive factors are present before and after the charter legislation in Texas and the subsequent entry of charter schools. Tiebout competition may involve high transactions costs – parents have to move across district campus or perhaps even district boundary lines in order to move schools - and private schools charge substantial tuition. Charter competition is unique in that parents may take advantage of the availability of a charter school at zero direct tuition cost and without moving across district boundaries. Thus the advent of charter schools and their growth over time allows a unique look at school competition. In an attempt to isolate the charter competition effect, we assume that the impact of Tiebout competition and private school competition is constant throughout this period of rising charter

[6] Bettinger (1999) , Bifulco and Ladd (2004, Eberts and Hollenbeck (2001), Greene and Forster (2002), and Holmes et. al. (2003) are examples of studies that use charter competition measures based on the distance between public campuses and surrounding charter schools.

[7] Empirical support for positive student achievement effects from Tiebout competition is found in Hoxby (2000).

[8] A recent paper on private school competition is Geller, et.al. (2002). This paper finds no significant effect of private school competition on public school performance.

competition, so that campus fixed effects should control for any differential availability of Tiebout competition and private school competition across campuses and districts.

When examining the effect of charter penetration, one important issue is how to define the amount of charter penetration that a traditional public school district or campus faces. We use two measures of charter penetration. The first, which we refer to as the district penetration measure, is the percent of public school students in a district that attend a charter school, relative to total (traditional public plus charter) public school enrollment in a district. This measure is an approximation to what is, arguably the ideal measure of realized competition, namely the percentage of public school students who reside in a particular district but who attend school at a charter.[9] We are unable, with our data, to generate a campus measure which mimics the district measure. However, by calculating the cumulative net flows of students to charters for each campus, we are able to develop a conceptually related measure of campus penetration by charters.[10]

The district penetration measure has the relative advantage of focusing on the impact of charters at the administrative level where fiscal decisions are made. Districts receive education dollars largely on a per student basis, and have a centralized decision process allocating resources among campuses. These district decision makers face the direct fiscal impact of students exiting to charters. The campus penetration measure provides a measure of charter penetration at an administrative level closer to the students we are observing. This measure indicates the realized impact of charter schools on campus enrollment, as measured by net students leaving a campus to enroll in a charter. The district penetration

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[9] The difference is due to inter-district charter moves. If such moves are minimal in number, or if they are reasonably symmetric among districts, then the difference between the two measures will be small.

[10] In each year the percentage outflow of students to charters at a given campus is the number of students at that campus in the previous year that we observe moving to a charter school in the current year, divided by the total number of students at that campus in the previous year and that we can observe in any public school (traditional or charter) in the current year. The percentage inflow of students from charters to a given campus is the number of students at the campus in the current year that we observe in charter schools in the previous year, divided by the total number of students at the campus in the current year that we can observe in any public school (traditional or charter) in the previous year. The net flow of students to charters at the campus in that year is the outflow minus the inflow.

measure is more of an indicator of the potential competition faced by a particular campus, since it measures overall charter enrollment relative to district enrollment. We find that use of these distinct measures of charter competition yields qualitatively similar results, indicating the robustness of our results to alternative measures of charter penetration.

Figure 1 presents our two measures of charter penetration for academic year 2001-02. We include only values for the charter penetration measure that are non-zero. The top two graphs place our district charter penetration on the horizontal axis, with either the number of districts or the number of students on the vertical axis. Thus the top left graph indicates that there are just over 20 districts with a measure of district charter penetration between 0.00 and 0.01, and just over 10 districts with a measure of district charter penetration between 0.01 and 0.02. The top right graph indicates that there are well over 600,000 students in those districts that have a charter penetration measure between 0.00 and 0.01, and over 200,000 students in those districts that have a charter penetration measure between 0.01 and 0.02. To put these numbers in perspective, there are 1041 districts in 2001-02, and only 56 districts have values greater than zero. For those 56 districts, the average value of the charter penetration measure is 0.026, with a maximum of 0.115. These 56 districts do, however, have a total enrollment of about 1.5 million, or about 37 percent of the total state enrollment.

The bottom two graphs in Figure 1 present the analogous graphs for our campus charter penetration measure. The bottom left graph indicates that there are nearly 1000 campuses with a campus charter penetration value between 0.00 and 0.01, and over 300 campuses with a campus charter penetration value between 0.01 and 0.02. The bottom right graph indicates that there are well over 600,000 students in those campuses that have a campus charter penetration measure between 0.00 and 0.01, and just at 200,000 students in those campuses that have a campus charter penetration measure between 0.01 and 0.02. Again to provide some perspective on these numbers, of those 4,472 campuses for which we have non-missing campus charter penetration measures in 2001-02, about 37 percent have campus charter penetration values

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The campus level charter penetration measure is then the sum of this net flow in the current year and all previous greater than zero. For those campuses with a measured charter presence, the average value of the campus charter penetration measure is 0.016, with a maximum of 0.287. Nearly half (46 percent) of the students are enrolled at these "competed" campuses.[11]

III. The Data

The data for this project were obtained from the Texas Education Agency and consist of district, campus and student level observations. The student level data consist of observations on all students in grades 3 through 8 (the grades in which the Texas Assessment of Academic Skills test, or TAAS test, is administered) from 1995 to 2002. Each student was given a unique identification number, which allows us to track individuals as long as they remain in the public school system. The data contain student, family, and program characteristics including gender, ethnicity, eligibility for a free or reduced price lunch (used here to indicate economically disadvantaged status), limited English proficiency, and participation in special education.[12]

The TAAS test in math and reading is administered in the spring to all eligible students in grades 3 through 8 and 10. Approximately 15% of students in the relevant grades do not take the test either because they are exempt or they are absent on testing days.[13] The TAAS math and reading tests each contain 40 questions. These are criterion referenced tests, so each year the TEA transforms the raw scores into the Texas Learning Index or TLI, which allows comparisons across school years and grades, and allows for evaluation of student progress. The TLI is a scaled score that ranges roughly from 0 to 100, with the

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years.

[11]The district enrollment values include all students in the district, whereas the campus enrollment numbers include only students at campuses for which we calculate a campus charter penetration measure. We do not calculate campus charter penetration measures for high school students; thus high school campuses are not included in the campus enrollment numbers.

[12] Due to confidentiality concerns at TEA, the data on student characteristics such as ethnicity are masked if there are fewer than five students in a cell in a single grade at a campus. Thus if there is only one Hispanic student in fifth grade at a school in particular year, that student's ethnicity is listed as missing. In addition, while we have an indicator for participation in special education, we do not have information on the student's specific disability. Thus the special education indicator encompasses a very wide range of students, from those with speech difficulties or learning disabilities to the deaf or blind.

passing standard fixed at 70. Raw scores are converted to TLI values by determining where the score would place the tested student in the reference year (1994) distribution, the year in which the passing standard was established. For example, if the passing standard had been set at the 40th percentile of the 1994 distribution, a student taking the test in 2002 scoring a raw score that would place him exactly at the 40th percentile of the reference distribution would be given a TLI score of 70. For a student whose score placed her one standard deviation above the passing level in the reference distribution, her TLI score would be set at 85, because the TLI is constructed such that one standard deviation in the reference population corresponds to 15 TLI points. TLI scores thus have a norm-referenced character. Because each student's performance is evaluated by reference to an earlier year's population, it is possible for the entire population to show positive average TLI score growth.[14]

In addition to student level data we utilize data on the composition of the student body at each campus. We include in our model the percentage of students by ethnicity, limited English proficiency, disadvantaged status, and enrollment in special education. This campus level demographic data is based on the entire student body rather than only those grades in which the TAAS is administered.

It is useful to identify the characteristics of students who attend charter schools in Texas, if only as background to our analysis of the competitive impact of those students remaining in traditional public schools. Charter schools as a whole are particularly heterogeneous in terms of student characteristics, as there are charters which enroll primarily gifted and talented students, as well as charters which service students who are performing poorly academically. Table 4 provides a comparison of students enrolled in charters schools with students enrolled in traditional public schools. Charter schools serve a substantially smaller share of Anglo students, and a substantially larger share of African-American students, than do traditional public schools. Charters have a larger percentage of economically disadvantaged students

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13 Certain special education students and limited English proficiency students are exempted from the TAAS if a school committee determines that the test is not educationally appropriate for the student.

[14] See the *TEA Technical Digest* for a complete description of the method of computing the TLI.

(defined as those eligible for a free or reduced price school lunch) than traditional public schools.[15] Finally, charters, on average, have lower percentages of their students labeled as special education students, a lower percentage of students labeled limited English proficiency, a lower proportion of gifted and talented students, and a lower proportion of students in career and technology programs.

IV. Empirical Model and Results.

We use a value-added measure of student performance, so that student – and school – performance is measured as the increase in a student's academic achievement. Rivkin, Hanushek and Kain (2001) argue that a value-added specification addresses a number of potential problems associated with omitted or mismeasured inputs, especially missing measures of school and family inputs from past years. Todd and Wolpin (2003) are less sanguine in their view of the value-added specification, and discuss the restrictions on education production technology implied by different specifications. The restricted value-added specification we employ (in which the coefficient on the lagged test score is fixed to unity) expresses the current year test score gain solely as a function of contemporaneous inputs and implies that the effect on test performance of an individual's ability endowment and of educational inputs is independent of age.

Our measure of academic achievement is the scaled score on the annual TAAS exam, called the TLI score, and our value added measure is the change in this TLI score. Our access to individual student data allows us to measure student performance as individual student change in TLI score, and to measure school performance as the school average of individual student change in TLI score. We call this measure TLI gains. In contrast, many researchers without access to student level data have looked at changes over time in school average test scores. For us this would be calculated as first averaging the TLI scores at a school for each year, and then calculating the change in this average TLI score over time.

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15 Note that this comparison treats as missing data the 31 charter schools that reported zero disadvantaged students. These are most likely schools that have chosen not to participate in the federal school lunch program, rather than

One possible concern is that charter schools may be locating in areas where students are poorly performing, so that comparing districts with charter penetration to those without also entails comparing districts with different levels of student achievement. In Table 5 we see that, in fact , the average TLI scores in math and reading are lower in those districts facing charter penetration than in those that do not face charter penetration. Because students with lower levels scores tend, on average, to have higher TLI gains, districts facing charter penetration will tend to have higher TLI gains than those districts not facing charter penetration. We employ student and campus fixed effects to address this concern, as these control for the unobservable time-invariant characteristics such as student ability and campus/district student composition. In addition, we provide estimates where we instrument for the charter penetration measure. These are described later in the text.

A limitation of some charter penetration studies is that the unit of observation is the campus. Thus regressions analyzing changes in the average test scores at a campus from one year to the next is the only option available to researchers. Our access to individual student data allows us to look at individual student gains in test scores from one year to the next, and to evaluate schools on the basis of the average of these gains. Using individual student data also allows us better to control for both observable and unobservable student characteristics.

In what follows we analyze student test score gains – actually TLI gains – using individual students as our unit of observation. Table 6 presents our first set of results. The first column is without campus or student fixed effects. We regress each student's math TLI gain on our district charter penetration measure, student indicators for gender, ethnicity, economically disadvantaged status, special education, limited English proficiency participation, indicators for the student's mover status, campus and district enrollment, and campus demographic percentages. These regressions include student observations in grades 4-8, and to control for differences over time and grade level each regression includes a complete

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schools that in fact have zero economically disadvantaged students.

set of year-by-grade indicators.

Two other technical issues merit mention. First, we excluded from our sample of traditional public school students any student that we ever observe in a charter school. By doing so we make sure that any change in student performance at traditional public schools is not due to selection of poorly performing (or highly performing) students into charters. Second, our estimation is on a randomly selected sample – usually one-third – of the population of student observations. This is done for computationally tractability.[16]

The coefficient of 0.14 on the district charter penetration measure is positive and statistically significant. Thus a one percentage point increase in charter penetration a district faces would increase math TLI gains by an average of 0.14 for students in that district. To interpret this coefficient, in a district facing five percent charter penetration (e.g. Dallas and Houston in 2001-02), the districts average student math TLI gains would be 0.72 higher than if they faced no charter penetration. The student-weighted district average math TLI level is 83.8 with a standard deviation of 3.09, so a five percentage point increase in charter penetration would increase the average gain in math by 0.23 standard deviations in the level. A sustained increase in the average math TLI gain could yield an even larger increase in average TLI levels, as individual students benefitted from the increased gains over multiple years.

The second column of Table 6 includes student fixed effects to control for time-invariant characteristics of individual students. One benefit of having a matched panel of students over time is that we can use student fixed effects to control for unobserved time-invariant student characteristics. Because student characteristics such as parental involvement and innate ability are believed to have strong effects on student performance it is important to control for these individual student characteristics. Additionally, controlling for student fixed effects allows us to address concerns that charter schools may be "cream-

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16 The random selection was by students, not student-year observations, so the resulting sample has the same average number of year observations per student as the full sample, as well as the same demographic distribution. The student level LSDV results from Table 6 yield nearly identical parameter estimates (to two decimal places) as those from the full student sample.

skimming" or "bottom feeding" or otherwise enrolling students from traditional public schools that differ in some systematic but uncontrolled way from students that remain in the traditional public schools. In this regard, note that adding student fixed effects increases the coefficient on the charter penetration variable in the math regression to 0.16.

The third column of Table 6 includes both campus and student fixed effects.[17] We add campus fixed effects in addition to student fixed effects in order to control for any time-invariant characteristics of the public school campuses. This specification takes full advantage of the panel data which we have assembled. Any stable differences between campuses will be captured by these fixed effects. Note that the coefficient on the charter penetration measure increases to 0.23 in math when both fixed effects are included. This indicates that a five percentage point increase in a district's charter penetration measure would correspond to over a one point increase in the value-added performance measure.

The degree of charter penetration that a district faces is not random, and may depend on the average performance of students in the district. For instance, if a school district tends to perform poorly, parents may become frustrated and seek alternative schooling options such as charter schools. This endogeneity of charter school location could bias estimates of the effect of charter penetration on student performance. Using student level data should alleviate, but may not eliminate these concerns, so we employ an instrumental variables approach to correct for potential endogeneity. We use the lagged value of the district's charter penetration measure, and the district's lagged passing rate on the TAAS test, as instruments for the district's charter penetration.

Our choice of instruments is driven by availability and by consideration of variables likely to be contemporaneously correlated with the measure of charter penetration – e.g., the district charter penetration measure – but contemporaneously uncorrelated with the error in the student achievement regression. Clearly a lagged value of the district-level charter penetration measure is (highly) correlated with the current value of itself. Our measure of student achievement is the student's gain in test score, the change in that student's score from the prior year to the current year. The error in the student achievement regression is assumed to be contemporaneously uncorrelated with last year's measure of district-level charter penetration. Given that an explanatory variable is the current year's measure of district-level charter penetration, and given that the dependent variable is the change in a student's test score, this assumption seems defensible. We also include as an instrument the lagged value of the district-wide passing rate on the TAAS test, where the passing rate is set by the state of Texas as a TLI score of 70. Again we are assuming that last year's district-wide passing rate is correlated with the current district charter penetration variable, but uncorrelated with the error term in the regression of a student's gain in test scores on current district charter penetration and other explanatory variables.

The last column of Table 6 shows the results for the instrumental variables specification with campus and student fixed effects. Note that in all of our student level instrumental variables regressions we use a randomly selected 15% sample of students as our regression sample. Here the coefficient on the charter penetration measure is 0.36, implying that a one percentage point increase in charter penetration a district faces would increase math TLI gains by an average of 0.36 for students in that district, or about 0.11 standard deviations of the average district math TLI level. Notice that the charter penetration coefficient increases in magnitude when we instrument for charter penetration, indicating that the LSDV estimates are perhaps biased towards zero.[18]

Table 7 reports the results of using reading TLI gains as the dependent variable. These are similar to the results using math gains in Table 6, with the estimated effect of district charter penetration ranging from 0.079 in the LSDV without fixed effects to 0.29 in the IV specification with campus and student fixed effects, and are all significantly different from zero. Again we find that the coefficient on charter

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17This joint student and campus fixed-effect specification is similar to the approach found in Bifulco and Ladd (2004), the only other charter competition study (of which we are aware) that utilizes panel data on individual students. We adopt a different, and arguably superior, measure of charter competition than is found in their study.

penetration using the IV estimators are higher than the coefficient estimates from the corresponding LSDV estimators. The student-weighted district mean of the reading TLI level is 87.1 with a standard deviation of 4.17, so the coefficient on charter penetration of 0.29 implies that a one percentage point increase in district charter penetration would increase reading TLI gains by an average of 0.29 for students in that district, or about 0.07 standard deviations of the average district reading TLI level.

Table 8 looks at the effect of the campus charter penetration measure on student performance in math and reading. Recall that our campus charter penetration measure is an alternative campus-level measure of students lost from each campus to charters. The first column shows the effect of charter penetration on math TLI gains, specified as LSDV with campus and student fixed effects, with an estimated coefficient on campus charter penetration of 0.14. The second column uses an instrumental variables specification (with both district and campus lagged values used as instruments for campus charter penetration), and the estimated effect of charter penetration increases to 0.17. Columns 3 and 4 show the same two specifications for reading TLI gains, with an estimated effect of charter penetration of 0.13 and 0.18 respectively. The results with the campus penetration measure are similar to those with the district penetration measure. We again find that increased charter competition, now at the campus level, leads to increased student performance, and the coefficient estimates are statistically significant. We also find the pattern, noted previously, that the IV estimates of the coefficient on charter penetration are higher than the corresponding LSDV estimates, indicating that the LSDV estimates are perhaps biased toward zero. Finally, the estimated impacts of campus charter penetration are smaller than the estimated impacts of district charter competition. Some of this may reflect conceptual differences in our two measures, since our district measure compares charter student enrollment of charters located in a district to that district's enrollment regardless of the source district of the charter students, whereas our campus measure compares students lost to charters by a specific campus to total enrollment at that campus. In interpreting this difference in magnitude, however, it is important to recognize that the coefficient on district charter

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18A Hausman test rejects the null hypothesis that charter penetration is exogenous.

competition measures the impact of, say, a 1% increase in charter penetration at the district level, whereas the campus charter competition measures the impact of a 1% increase in charter penetration a the campus level. It is possible, and even likely, that the administrative response of a district in terms of reallocating resources is greater when the district loses 1% of district-wide students to charters than when a campus within the district loses 1% of its students to a charter.

Although the magnitude of the relationship between charter penetration and student achievement varies somewhat, both within and across Tables 6 through 8, the evidence of a positive and significant effect of charter penetration is quite consistent. We are not able to identify the particular mechanisms which are driving this observed relationship. As identified in the introduction, possible explanations would include increased efficiency and positive compositional/peer effects. It is also possible that the increased performance occurs because districts allocate more resources to schools that face more charter penetration. A detailed analysis of this issue is beyond the scope of this paper, but a preliminary look at district per pupil expenditures provides no evidence that districts facing charter penetration have systematically increased their expenditures per pupil faster than those that do not face charter penetration. Expenditures per pupil for districts expenditures per pupil for districts that had positive charter penetration in 2002 grew 38.2% between academic year 1996-97 and 2001-02. In comparison, expenditures per pupil in districts that had no charter penetration in 2002 grew by 39.7%, a slightly higher rate, over this same period.

An interesting issue with potential policy implications is the possibility for differential impacts of charters across campuses. We address this issue by asking if the student performance gains from charter penetration occur mostly in high-performing campuses or mostly in low-performing campuses. We develop a ranking of campuses in the 1995-96 academic year, the year prior to the beginning of our sample, on the basis of the percentage of students at each campus passing the TAAS test (all grades, all tests). We create indicators to assign each campus into quintiles according to this ranking, and interact these indicators with our measure of charter competition. Our models already include student and/or campus fixed effects, so that we already control for time-invariant campus characteristics, but the magnitudes of the estimated coefficients on these interaction terms allow us to draw conclusions about the differential impact of charter penetration on students at a campus by campus performance level in 1995-96.

Table 9 reports results for the student math TLI gains and student reading TLI gains when we use the district charter penetration measure. We report results for a regression with no fixed effects for the sake of comparison with prior tables, and results for a regression with the full set of campus and student fixed effects. Looking at the campus and student fixed effect results, it is clear that district charter penetration had a relatively large and highly significant impact on students when their campus was in the lowest two quintiles in 1995-96. Conversely, district charter penetration had a negative and significant impact on students when their campus was in the highest quintile in 1995-96. District charter competition had a relatively small and statistically insignificant impact on students when their campus was in the third or fourth quintile in 1995-96. These results are consistent when student performance is measured by math TLI gains or by reading TLI gains.

The results in Table 9 suggest that charter penetration is effective at raising student performance levels of students remaining behind in traditional public schools especially when students are at schools that were performing below average in 1995-96. Thus charter penetration increases performance of students at traditional public schools, and differentially increases the performance of students at traditional public schools that were underperforming relative to other public schools.

Table 10 reports analogous results when we use the campus charter penetration measure. Focusing on the regressions with campus and student fixed effects, we see that the pattern from Table 9 is reproduced here as well. The coefficient on campus charter penetration is of relatively high magnitude and highly significant for campuses in Quintile 1 and Quintile 2. This coefficient is negative and statistically significant for campuses in Quintile 5. Finally, for Quintile 3 and Quintile 4 this coefficient is small in magnitude and statistically insignificant. Again, as measured by our campus charter penetration measure, student test score gains respond differentially to charter penetration depending on whether the student's campus was underperforming or overperforming in 1995-96. The growth of charters as alternatives to traditional public schools has led to increased test score gains at traditional public schools, and differentially impacted student test scores at previously lower-performing campuses.[19]

Finally, we take a look at charter competition with the campus, rather than the individual student, as the unit of observation. This will provide a more direct comparison with results of previous studies of charter competition, in particular with results found in Hoxby (2003). We report in Table 11 the results if we use our data to run the charter penetration regressions at the campus level. These regressions use the average TLI gains of the 4-8th grade students at the campus as the dependant variable, and estimate the effect of our district charter penetration measure on campus performance. We also include year indicators, indicators for campus type, campus and district enrollment, and campus demographic percentages, as well as campus fixed effects. The effect of district charter penetration on math TLI gains is very similar in the campus level regressions as it was at the student level, with a coefficient of 0.20 under LSDV and 0.26 with instrumental variables. The estimated effect of campus charter penetration on reading in columns 3 and 4 is still positive and significant, but the estimated coefficients of 0.032 under LSDV and 0.062 with IV are considerably lower in magnitude than those estimated in the student level regressions.[20]

V. Conclusions

We find that the emergence of charter schools has had a positive impact on student performance – at least in terms of test scores – for students remaining in traditional public schools in Texas. This positive effect is consistent across both math and reading tests, both district and campus level penetration measures,

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19 These results raise an interesting question: Does charter competition lead districts to reallocate resources to poorly performing campuses and away from highly performing campuses? This may be especially interesting because charters seem to provide competition for public schools more at the lower end of the student performance levels, whereas other sources of competition such as private schools may provide competition for students at the upper end of student performance levels.

20 Hoxby (2003) used an indicator for whether a district faced at least 6% charter penetration, and found a positive effect of this indicator on campus performance gains. We find similar results when an indicator for a district facing three or four percent charter penetration is used in place of the district's actual charter penetration percent.

and across a variety of specifications. Although the estimated effect is relatively small, a persistent increase in value-added achievement by schools could lead to substantially higher student achievement levels.

The evidence in this paper supports claims that expanding school choice may generate systemic gains. Whether such gains would be realized under broader choice institutions, such as vouchers, is uncertain. Future research on the charter experiment which focused upon identifying the sources of gains from competition would help inform the general relevance of our findings. The relevance of school choice policies within the current policy environment rests upon the accumulation of evidence, such as ours, that children who stay behind are not necessarily left behind.

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Table 1. Number and Enrollment of Charter Schools in Texas

	Charter Schools		Percent of Public School Students
Year	Number in Operation	Enrollment	
2001-02	179	46,939	1.13 %
2002-01	158	37,956	0.93 %
1999-00	142	25,687	0.64 %
1998-99	61	12,226	0.31 %
1997-98	19	3,856	0.10 %
1996-97	16	2,412	0.06 %
1995-96	0	0	--

Table 2. Charter Schools by County and County Population, 2001-2002

County or Counties	Number of Charter Schools	Population in County (or Counties)*	Percent of Texas Population
Charters in Major Metropolitan Counties:			
Bexar (San Antonio)	21	1,392,931	6.7 %
Dallas (Dallas)	28	2,218,899	10.6 %
El Paso (El Paso)	4	679,622	3.2 %
Harris (Houston)	43	3,400,578	16.3 %
Tarrant (Ft. Worth)	8	1,446,219	6.9 %
Travis (Austin)	10	812,280	3.9 %
Charters in Other Counties:			
Hidalgo	7	569,463	2.7 %
Jefferson, Nueces	5 each	565,696	2.7 %
Lubbock	4	242,628	1.2 %
Bell, McLennan, Midland, Smith	3 each	742,206	3.6 %
Brazos, Cameron, Galveston, Hays, Webb	2 each	1,028,506	4.9 %
Angelina, Bee, Bowie, Brooks, Comal, Denton, Ellis, Erath, Gregg, Hunt, Lampasas, Montgomery, Panola, Potter, Real, Somervell, Taylor, Uvalde, Val Verde, Van Zandt, Walker, Wichita	1 each	1,949,691	9.4 %
Total Population of Texas		20,851,820	100 %
TX Counties with Charters - 41 counties	179 charters	14,965,719	72.8 %
TX Counties without Charters - 213 counties	0 charters	5,886,101	28.2 %

* Source: Bureau of the Census, GCT-PH1: Population, Housing Units, Area, and Density: 2000 Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data, Geographic Area: Texas

Table 3. Charter Penetration of School Districts

Academic Year	Districts with Charters	Enrollment in Public School Districts with Charters	Percent of Overall Public School Enrollment
2001-02	67	1,738,360	41.9 %
2000-01	59	1,587,469	39.1 %
1999-00	40	963,714	24.2 %
1998-99	21	940,460	23.9 %
1997-98	10	632,311	16.3 %
1996-97	5	158,765	4.2 %
1995-96	0	0	0

Table 4. Student Demographics: Charters vs. Traditional Public Schools, 2001-2002

Student Group	Charter Schools (179)	Traditional Public School Districts (1,041)	Public School Districts facing Charter Penetration (67)
Anglo	20.4 %	41.1 %	27.7 %
African-American	39.7 %	14.1 %	18.9 %
Hispanic	38.3 %	41.7 %	50.4 %
Asian	1.3 %	2.8 %	2.6 %
Native American	0.2 %	0.3 %	0.3 %
Economically Disadvantaged	57.6 %	50.4 %	59.5 %
Limited English Proficiency	6.7 %	14.6 %	19.6 %
Special Education	9.0 %	11.7 %	11.3 %
Career & Technology	11.7 %	19.4 %	18.5 %
Gifted & Talented	1.7 %	8.3 %	8.9 %
At-Risk	47.3 %*	32.0 %*	35.4 %*

* At-Risk percentages taken from campus level TAAS data, and reflect % at-risk in grades 3-8 and 10

Table 5. Distribution of Math and Reading TLI, 2001-2002

	Grades 4-8			
	Math		Reading	
	Facing Some Charter Penetration	Not Facing Charter Penetration	Facing Some Charter Penetration	Not Facing Charter Penetration
TLI Levels				
Mean	84.0	85.3	87.8	89.6
Std. Dev.	8.0	7.0	11.4	10.2
25^{th} percentile	81	83	83	86
Median	87	88	92	93
75^{th} percentile	89	90	96	96
# of obs.	397,198	738,595	391,331	729,505
TLI Gains				
Mean	1.69	1.41	2.59	2.17
Std. Dev.	6.40	5.62	8.18	7.42
25^{th} percentile	-2	-1	-2	-2
Median	1	1	2	2
75^{th} percentile	4	4	7	6
# of obs.	397,198	738,595	391,331	729,505

Table 6. Effect of District Charter Penetration on Math Performance

Dependent Variable	Student Math TLI Gain					
Explanatory Variable	District Charter Penetration Measure					
Regression Type	LSDV			IV		
Fixed effects included	None	Student	Campus and Student	None	Student	Campus and Student
Charter penetration	0.141 (.006)	0.155 (.013)	0.231 (.013)	0.179 (.010)	0.312 (.027)	0.356 (.029)
Female	0.133 (.0087)	-	-	0.136 (.013)	-	-
Black	0.651 (.017)	-	-	0.654 (.025)	-	-
Hispanic	0.269 (.014)	-	-	0.287 (.020)	-	-
Economically disadvantaged	0.065 (.011)	-	-	0.055 (.017)	-	-
Special education	0.629 (.019)	0.401 (.052)	0.394 (.052)	0.625 (.028)	0.362 (.078)	0.361 (.077)
Limited English proficient	1.603 (.024)	-	-	1.589 (0.036)	-	-
Moved district (public - public)	0.028 (.018)	0.012 (.026)	0.039 (.026)	0.027 (.026)	-0.042 (.040)	0.004 (.039)
Moved campus within district	-0.315 (.019)	-0.309 (.026)	-0.107 (.027)	-0.327 (.028)	-0.350 (.039)	-0.139 (.040)
Observations	2,767,291	2,773,271	2,773,271	1,243,808	1,246,466	1,246,466

* also included year by grade dummies, campus demographic percentages, and campus and district enrollments

Table 7. Effect of District Charter Penetration on Reading Performance

Dependent Variable	Student Reading TLI Gain					
Explanatory Variable	District Charter Penetration Measure					
Regression Type	LSDV			IV		
Fixed effects included	None	Student	Campus and Student	None	Student	Campus and Student
Charter penetration	0.079 (.007)	0.257 (.016)	0.195 (.016)	0.089 (.012)	0.383 (.034)	0.285 (.036)
Female	0.042 (.010)	-	-	0.041 (.015)	-	-
Black	0.097 (.020)	-	-	0.089 (.030)	-	-
Hispanic	-0.006 (.016)	-	-	0.004 (.024)	-	-
Economically disadvantaged	-0.089 (.013)	-	-	-0.084 (.020)	-	-
Special education	0.420 (.023)	0.415 (.065)	0.388 (.065)	0.411 (.035)	0.512 (.097)	0.493 (.096)
Limited English proficient	2.688 (.029)	-	-	2.641 (.043)	-	-
Moved district (public - public)	-0.142 (.021)	-0.054 (.032)	-0.049 (.032)	-0.117 (.032)	-0.086 (.049)	-0.074 (.048)
Moved campus within district	-0.388 (.022)	-0.412 (.032)	-0.222 (.033)	-0.439 (.034)	-0.480 (.048)	-0.295 (.049)
Observations	2,737,189	2,743,106	2,743,106	1,229,385	1,232,043	1,232,322

* also included year by grade dummies, campus demographic percentages, and campus and district enrollments

Table 8. Effect of Campus Charter Penetration on Math and Reading Performance

Explanatory Variable	Campus Penetration Measure			
Dependent Variable	Student Math TLI Gain		Student Reading TLI Gain	
Regression Type	LSDV	IV	LSDV	IV
Fixed effects included	Campus and Student	Campus and Student	Campus and Student	Campus and Student
Charter penetration	0.138 (.016)	0.171 (.039)	0.128 (.020)	0.177 (.047)
Special education	0.406 (.055)	0.388 (.082)	0.400 (.068)	0.515 (.102)
Moved district (public - public)	0.057 (.028)	0.033 (.042)	-0.026 (.034)	-0.067 (.052)
Moved campus within district	-0.097 (.029)	-0.148 (.043)	-0.230 (.035)	-0.322 (.053)
Observations	2,570,573	1,143,881	2,542,684	1,130,552

* also included year by grade dummies, campus demographic percentages, and campus and district enrollments

Table 9. Differential Effect on Student Achievement at Low and High Performing Campuses of District Charter Penetration

Dependent Variable	Student Math TLI Gain		Student Reading TLI Gain	
Explanatory Variable	District Charter Penetration Measure			
Regression Type	LSDV		LSDV	
Fixed effects included	None	Campus and Student	None	Campus and Student
Charter penetration * Quintile 1	0.144 (.013)	0.395 (.030)	0.114 (.016)	0.399 (.037)
Charter penetration * Quintile 2	0.213 (.016)	0.302 (.036)	0.106 (.020)	0.227 (.044)
Charter penetration * Quintile 3	0.106 (.017)	-0.012 (.040)	0.015 (.021)	0.043 (.050)
Charter penetration * Quintile 4	0.171 (.024)	0.116 (.064)	0.078 (.029)	-0.025 (.078)
Charter penetration * Quintile 5	0.011 (.024)	-0.188 (.064)	0.016 (.028)	-0.280 (.078)
Female	0.125 (.013)	-	0.047 (.016)	-
Black	0.636 (.026)	-	0.071 (.031)	-
Hispanic	0.286 (.021)	-	-0.009 (.025)	-
Economically disadvantaged	0.049 (.017)	-	-0.083 (.021)	-
Special education	0.629 (.029)	0.392 (.081)	0.431 (.036)	0.507 (.101)
Limited English proficient	1.554 (.037)	-	2.630 (.045)	-
Moved district (public - public)	0.045 (.028)	0.019 (.042)	-0.122 (.033)	-0.061 (.051)
Moved campus within district	-0.342 (.030)	-0.139 (.043)	-0.463 (.036)	-0.304 (.052)
Observations	1,165,516	1,168,123	1,151,988	1,154,599

* also included year by grade dummies, campus demographic percentages, and campus and district enrollments

** Quintile 1 is an indicator for campuses in the lowest quintile of campuses ranked by campus-wide TAAS passing rates (all tests, all grades) in academic year 1995-1996. Quintile 2 through Quintile 5 are indicators for the 2nd through 5th quintile of campuses so ranked.

Table 10. Differential Effect on Student Achievement at Low and High Performing Campuses of Campus Charter Penetration

Dependent Variable	Student Math TLI Gain		Student Reading TLI Gain	
Explanatory Variable	Campus Charter Penetration Measure			
Regression Type	LSDV		LSDV	
Fixed effects included	None	Campus and Student	None	Campus and Student
Charter penetration C Quintile 1	0.152 (.018)	0.254 (.043)	0.072 (.022)	0.380 (.052)
Charter penetration C Quintile 2	0.189 (.020)	0.258 (.048)	0.075 (.024)	0.166 (.059)
Charter penetration C Quintile 3	0.130 (.023)	-0.011 (.055)	0.016 (.028)	0.052 (.069)
Charter penetration C Quintile 4	0.070 (.019)	0.021 (.054)	0.077 (.023)	0.021 (.065)
Charter penetration C Quintile 5	0.020 (.029)	-0.143 (.078)	0.020 (.037)	-0.326 (.099)
Female	0.125 (.014)	-	0.047 (.016)	-
Black	0.638 (.026)	-	0.079 (.031)	-
Hispanic	0.291 (.021)	-	-0.009 (.025)	-
Economically disadvantaged	0.048 (.017)	-	-0.083 (.021)	-
Special education	0.636 (.029)	0.385 (.082)	0.443 (.036)	0.519 (.102)
Limited English proficient	1.577 (.037)	-	2.654 (.045)	-
Moved district (public - public)	0.057 (.028)	0.028 (.042)	-0.118 (.033)	-0.065 (.052)
Moved campus within district	-0.320 (.030)	-0.135 (.043)	-0.456 (.036)	-0.310 (.053)
Observations	1,152,102	1,154,536	1,138,687	1,141,131

* also included year by grade dummies, campus demographic percentages, and campus and district enrollments

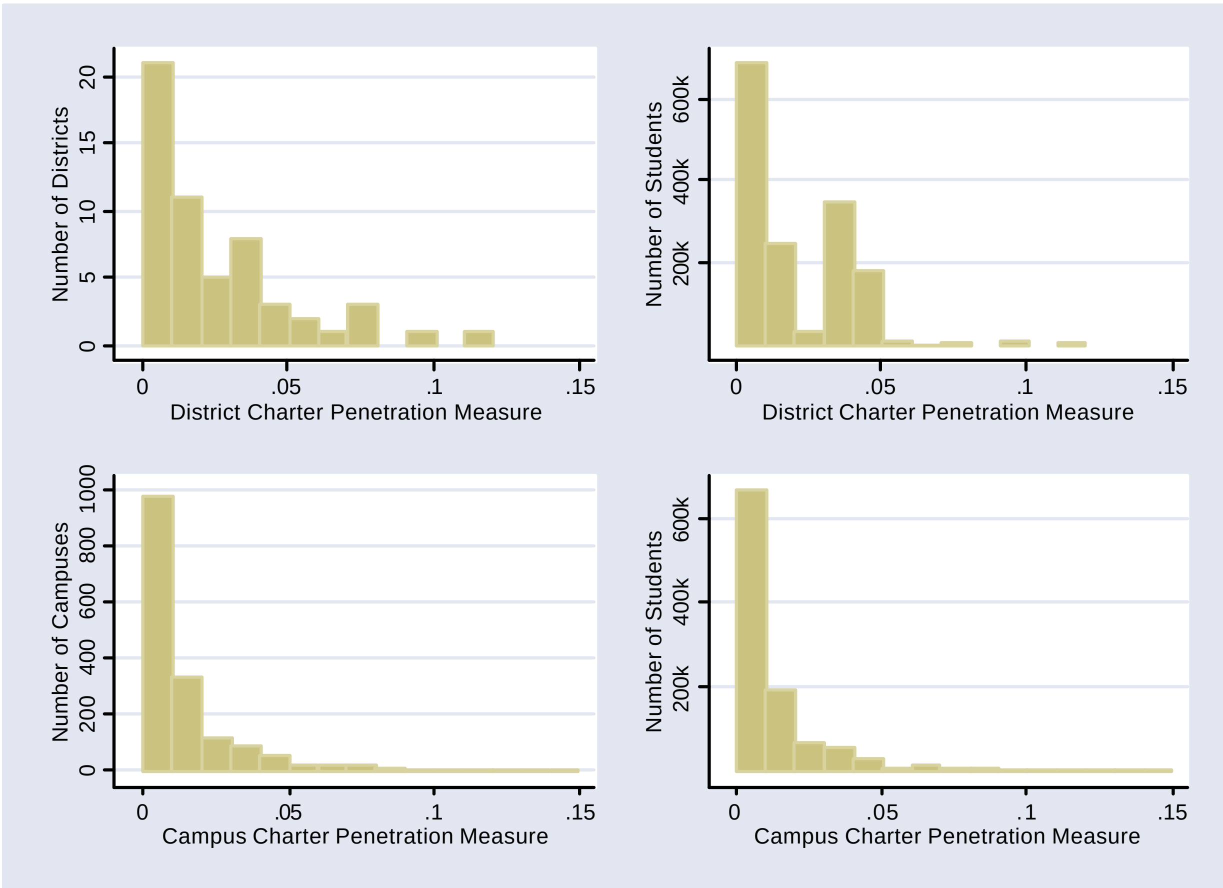
** Quintile 1 is an indicator for campuses in the lowest quintile of campuses ranked by campus-wide TAAS passing rates (all tests, all grades) in academic year 1995-1996. Quintile 2 through Quintile 5 are indicators for the 2nd through 5th quintile of campuses so ranked.

Table 11. Campus Level Charter Penetration Regressions

Explanatory Variable	District Penetration Measure			
Dependent Variable	Campus Average of Student Math TLI Gains		Campus Average of Student Reading TLI Gains	
Regression Type	LSDV	IV	LSDV	IV
Charter penetration	0.197 (.018)	0.260 (.021)	0.032 (.017)	0.063 (.020)
Middle school	-0.549 (.189)	-0.567 (.187)	-0.518 (.179)	-0.522 (.178)
High school	-0.549 (.275)	-0.545 (.272)	-0.153 (.260)	-0.139 (.259)
K-12 campus	-0.424 (.213)	-0.417 (.211)	-0.202 (.203)	-0.187 (.201)
Campus percent Black	0.473 (.431)	0.648 (.430)	-0.353 (.409)	-0.281 (.409)
Campus percent Hispanic	0.227 (.386)	0.351 (.388)	-0.698 (.367)	-0.672 (.369)
Campus percent Economically disadvantaged	0.989 (.201)	0.960 (.202)	0.644 (.190)	0.615 (.192)
Campus percent Special education	-1.159 (.427)	-1.453 (.428)	0.625 (.407)	0.703 (.408)
Campus percent Limited English proficient	3.322 (.334)	3.241 (.334)	2.660 (.317)	2.620 (.318)
Observations	39,225	38,916	39,222	38.913

* also included are campus and year dummies, and campus and district enrollments

Figure 1: Distribution of District and Campus Charter Penetration Measures in 2001-02



Note: This figure excludes districts for which the charter penetration measure was zero.