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Charter school quality and parental decision making with school choice ☆

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Abstract

Charter schools have become a very popular instrument for reforming public schools, because they expand choices, facilitate local innovation, and provide incentives for the regular public schools while remaining under public control. Despite their conceptual appeal, analysis has been hindered by the selective nature of their student populations. This paper investigates the quality of charter schools in Texas in terms of mathematics and reading achievement and finds that average school quality in the charter sector is not significantly different from that in regular public schools after an initial start-up period but that there is considerable heterogeneity. Perhaps more important for policy, however, is the finding that the parental decision to exit a charter school is significantly related to school quality. The magnitude of this relationship is substantially larger than the relationship between the probability of exit and quality in the regular public school sector and consistent with the notion that the introduction of charter schools substantially reduces the transactions costs of switching schools.

Charter schools have been championed as the politically feasible form of school choice that offers most of the advantages of school voucher without sacrificing the benefits of government

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oversight. The freedom from many of the constraints under which regular public schools operate allows for a diversity of educational approaches and increased competition within the public sector. In just ten years of development, they are found in over three-fourths of the states and their enrollment exceeds 4% of the public school population in some states. Nonetheless, even though charter schools have captured the imagination of many school reformers and the ire of others, little credible evidence about their impact on student achievement is available.[1] This comes about primarily because of the difficulty separating differences in the quality of charter and regular public schools from differences in the students who attend schools in the respective sectors.

This paper uses panel data for the state of Texas to overcome impediments to the evaluation of charter school performance and to investigate the quality of charter schools relative to traditional public schools. Additionally, it provides a first glimpse at how the availability of charter schools affects the ways in which parents respond to school quality differences. By eliminating the need to move residences in order to switch schools, charter schools would be expected to lead to an increase in the sensitivity of parents to school quality and amplify the competitive pressure on public schools.

Although the exact character differs by state, charter schools are hybrids of public and private institutions that allow independent development and decision-making along with public financing and state accountability for performance. Charter schools are funded by state and local governments but are exempted from many of the state and local regulations that school reformers have argued stifle innovation and reduce the effectiveness of public schools (Nathan, 1996). To achieve charter status, a school must develop an acceptable educational plan (their charter) and attract sufficient students to be economically viable. Although appealing as an institutional device to encourage innovation, charter schools are frequently started by people with relatively little experience at either developing new enterprises or running schools.[2] By any standard, running effective schools is complex. Thus, the public policy issue is how these opposing forces – enthusiasm, freedom, and innovation versus inexperience, complexity, and multiple objectives – net out in terms of student achievement.

The nation's first charter school legislation was enacted into law in Minnesota in 1991, and by 2006 charter schools were operating in some 40 states and the District of Columbia.[3] During this period the charter school sector grew from a handful of schools serving a small number of students to almost 4000 schools serving an estimated 1.15 million students, approximately 2% of the public school population. Much of the research and discussion of charter schools focuses on their growth and student characteristics (e.g., see U.S. Department of Education, 1999; Finn et al., 2000). This paper, however, fits into the smaller body of evidence on charter school quality as measured by student performance.[4]

Our analysis of Texas charter schools concentrates entirely on student achievement in mathematics and reading. Even though some charter schools may emphasize a variety of nonacademic goals including, for example, moral and ethical standards or discipline and safety,

[1] Evidence of the intensity of the debate was clear in late 2004 when a controversy was ignited by the publication of an analysis by the American Federation of Teachers (Nelson et al., 2004) and its wide media coverage. This drew both public and professional reactions (see Hoxby, 2004).

[2] For a description of charter schools including both the legislation surrounding them and the heterogeneity of the sector, see Finn et al. (2000).

[3] Current data about charters is fragmentary and must be pieced together from various private sources. See Center for Education Reform (http://www.edreform.com/).

[4] In between the descriptive studies of charter schools and their populations and the evaluations of student performance, Hoxby (2002) examines the impact of charter schools on teacher hiring.

we presume that producing basic academic skills remains a central matter for both individuals and society.

Similar to research on public–private school differences, the existing research on charter school quality focuses on whether the average charter school is better or worse than the average regular public school for all students and for selected demographic groups. We also begin by investigating sector average differences, using the rich panel data to separate the impacts of charters from the other forces that determine achievement. Our results indicate that, although charter schools have difficult start-up periods, they settle down within roughly four years and are not significantly different than traditional public schools on average in terms of value added to reading and mathematics achievement. Although there is little or no evidence of differential effects by race, ethnicity, or income, the charter school deficit appears to be smaller for students with higher initial achievement.

The most novel and potentially most important aspect of this work from a policy perspective, however, concerns the responsiveness of parents to school quality in their decision to leave a school. As we document below, there is substantial variation in school quality as measured by value added to mathematics and reading achievement in both the charter and regular public school sectors. Because charter school students can return to a regular public school without moving residences and because most regular public schools do not have a charter school nearby, charter school parents would be expected to be more responsive to quality. This is precisely what we find, satisfying a necessary condition for the education market to favor higher quality charter schools over time. However, the full market dynamics also depend on the character of entry into charters — something that we cannot investigate here.

The next section provides a brief overview of the charter school market in Texas. Section 2 develops the analytical approach used to evaluate charter school performance, focusing on the problems introduced by the endogeneity of school choice. The subsequent section examines average quality differences between charter and regular public schools for all students and by demographic characteristics and initial achievement. Section 4 investigates the relationship between the probability of exiting a school and a number of measures of school quality including the state accountability rating and estimates of school value added. The final section summarizes the results and policy implications and describes potential extensions for future work.

1. The Texas charter school program

Texas – the focus of analysis here – is one of the most active charter school states. Since enacting charter school legislation in 1995, the Texas charter sector has grown into one of the largest, ranking fourth among the states in both number of charter schools and number of students in 2004. Because Texas offers a large and diverse set of charter schools, it can provide insights about the potential implications of pursuing this reform strategy.

The Texas Education Code established three types of charter schools: home rule school districts, campus or program charters, and open enrollment schools.[5] Open enrollment schools receive their charters directly from the state, while campus and program charters receive their charters from the local districts. The largest number falls under the open enrollment charters governed by the State Board of Education. The Texas legislature placed limits on the number of

[5] Extensive descriptions of charter schools in Texas can be found elsewhere. See Texas Center for Educational Research (2003), Booker et al. (2004), and Gronberg and Jansen (2005). Their descriptions do not correspond exactly to our samples because of differences in sample selection criteria described below.

Table 1
Charter and regular public school annual exit rates by destination, grade, income and ethnicity (exit rates calculated only for schools that offer the next grade)

Destination	% of charter school students annually exiting to:			% of regular public school students annually exiting to:		
	Other charter	Regular	Out of Texas public schools	Charter	Other regular	Out of Texas public schools
All students	2.0	20.0	17.9	0.1	11.0	6.6
Grade						
4th to 5th grade	2.1	22.3	22.8	0.1	12.6	7.2
5th to 6th grade	1.9	22.8	19.1	0.1	12.2	6.5
6th to 7th grade	1.9	19.8	15.5	0.1	10.5	7.0
7th to 8th grade	2.1	18.5	17.5	0.1	8.7	6.2
Income						
Disadvantaged	1.9	20.7	19.3	0.2	13.3	8.2
Not Disadvantaged	1.9	20.5	17.9	0.1	8.9	5.4
Ethnicity						
Black	3.1	26.8	22.2	0.3	15.7	8.4
Hispanic	1.5	17.6	14.6	0.1	11.0	6.7
White	1.5	19.5	16.1	0.1	9.6	5.5

charter schools that could be operated under the open enrollment program, and this limit has been raised since the introduction of the program in 1995. In 2002, the limit on open-enrollment charters was raised to 215 but a previously uncapped category for schools serving 75% or more at-risk students was folded into the total.

Prior to 1997 there were only a handful of charter schools in Texas, but since then the percentage of 4th through 8th grade public school students attending charter schools has risen from 0.03% in 1997 to roughly 1% in 2002. Participation in charter schools varies substantially by ethnicity and to a lesser extent by family income. Blacks are over-represented and whites under-represented in charter schools, while the proportion of students who are of Hispanic origin is quite similar in both the charter and regular public school sectors. Interestingly, the differences among ethnic groups are far larger than the differences by family income despite the fact that the initial charter legislation favored schools for disadvantaged populations. (Note, however, that the crude measure of income captured by eligibility for subsidized lunch may conceal important differences by economic circumstances).

Black students are more likely to attend a charter than students of other race or ethnic groups, and their charter schools have a higher average black enrollment share than the regular public schools attended prior to charter school entry (not shown). Our previous work on racial composition in Texas found that higher black enrollment reduced achievement for blacks (Hanushek et al., 2002b). However, it is possible that additional segregation resulting from charter school enrollment may have less adverse consequences than racial separation in the regular public school sector.

The dramatic growth in charter schools has important implications for our analysis, because it means that our observations are heavily weighted toward recently opened charter schools. Booker et al. (2004) show that roughly half of the Texas charter school students in their sample are in their first year in a charter, a situation similar to that for our sample. By comparison, most 4th, 5th and 8th grade students in regular public schools are not in their first year of the specific school, while 6th and 7th graders in regular public schools are much more similar to charter students in that

regard. Roughly 40% of middle school students (lowest grade is sixth) and over 50% of junior high students (lowest grade is seventh) are in their first year in the school. Thus entering a charter school differs from entering a regular public middle school in many but certainly not all dimensions.

An important aspect of charter schools, at least at this stage of development, is that the average exit rate substantially exceeds average turnover in regular public schools (see Table 1).[6] A portion of this appears to be compositional, as the black enrollment share is higher in charter than in regular public schools, and, independent of sector, blacks have a higher mobility rate than Hispanics or whites (Hanushek et al., 2004). Nonetheless, mobility rates for students in charter schools are substantially above those in regular public schools, not surprising given the ease with which charter school students can switch to another public school.

The large fraction of charter students in their first year and high turnover including a much higher exit rate out of Texas public schools necessitates appropriate treatment of mobility and student heterogeneity. Our prior work (Hanushek et al., 2004) that investigated mobility in regular public schools found that moving tends to affect adversely both the mover and schoolmates in the new school.[7] In this paper we take a number of steps to both account for that mobility and examine the sensitivity of the results to the mobility controls.[8] Although we are unable to follow students who leave the Texas public schools, the mere fact that such exits are much more likely for charter school students raises the possibility of unobserved family differences that may confound the estimates if not adequately addressed.

2. An empirical model of charter school effects

Uncovering the effects of charter schools on achievement is difficult primarily because charter school attendance is not an accident but rather an outcome of charter school supply decisions and the decision to send a child to a charter. Examination of Fig. 1, kernel density estimates of the distributions of the level of average test scores for charter and regular public schools, illustrates the key issues. The figure reveals substantial variation within each sector and a charter school distribution that is to the left of the distribution for regular public schools. Although these distributions in part reflect the distributions of school quality in the respective sectors and of test measurement error, they also reflect the distributions of student, family, and neighborhood characteristics that are key to the charter school distribution itself. Simple mean achievement comparisons between sectors conflate average differences in school effectiveness with mean differences in other achievement determinants. Controlling for family and community background and even initial achievement certainly mitigates the effects of student sorting, but research on private school, peer, class size, and other types of school effects raise doubts that typically available variables fully account for the nonrandom selection of students into neighborhoods and schools. This has contributed to the use of instrumental variables, random assignment experiments, and other methods designed to account for remaining confounding factors.

[6] Exit rates computations exclude students for whom the next grade is not available in their current school.

[7] The exact cause of this achievement loss is difficult to ascertain. Many moves are associated with other family disruptions – divorce, job loss, and the like – and it is not possible to partition the losses between school adjustment factors and nonschool factors; see Hanushek et al. (2004).

[8] We do not observe where a student goes following an exit from the Texas public schools. Although we can observe mobility across all public schools in the state, including charters, we have no way of tracking movement to private schools or out of the state. We interpret the larger exit rates from Texas public schools as arising primarily from private school attendance.

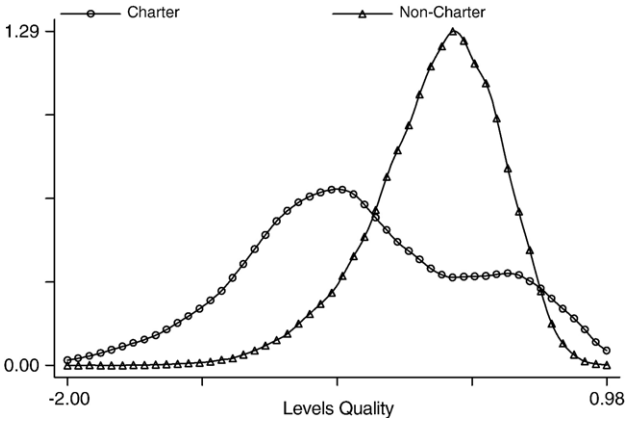

Fig. 1. Distribution of achievement levels for charter and regular public schools.

2.1. Research on private and charter school effects

Research on public–private school differences is particularly relevant to this study. Starting with the work by Coleman et al. (1982), the debate has centered largely on whether a methodology is able to account for the nonrandom selection of students into private schooling.[9] One line of research has sought to deal with this problem by modeling the selection process itself. Specifically, if one can obtain a consistent estimate of the probability of attending a private school, it is possible to correct the models of achievement for this in the spirit of Heckman (1979). The typical problem with this approach, however, is that it is difficult to find factors that drive selection into private schools but that are unrelated to achievement. A number of papers including Evans and Schwab (1995) and Neal (1997) use information on religion as instruments to identify public–private school differences, an interesting approach but without straightforward application to the charter school case.

An alternate methodology, used first in the analysis of school voucher programs, concentrates on intake randomization. If there is excess demand for a program (say, a privately offered school voucher) and if participants are chosen randomly from those applying, a comparison of those admitted with those not admitted provides information on program performance (e.g., Howell and Peterson, 2002). Such an approach circumvents some of the most serious problems about unobserved influences and student selection on scores. At the same time, these evaluations limit the comparison to those who have selected into the lottery for the specific program and practical problems with attrition and nonrandom selection raise some questions about the validity of many such experiments.

This intake randomization approach has recently been applied to charter schools. Relying on a frequently observed aspect of state charter laws — that they must choose students by random when there is excess demand, Hoxby and Rockoff (2004) estimate charter school impact by mean differences in performance of those accepted and those denied admission to three schools operated in Chicago by a common charter school authorizer. They find that the benefits of a

[9] Murnane et al. (1985) discuss the difficulties of isolating the impact of private schools on achievement. Studies of the public–private school quality difference include Evans and Schwab (1995), Sander (1996, 2001), Neal (1997), and Grogger and Neal (2000).

charter school education are inversely related to the grade at which a student enters a charter. However, a lack of information on the initial achievement levels of early entrants inhibits investigation of the possibility that differential attrition by lottery winners and losers contaminates the estimates. In addition, the small number and specific characteristics of the charters limit the generalizability of the results.

Our approach and that used by several other studies takes advantage of panel data to account for systematic factors related to choices that affect both the probability of attending a charter school and achievement.[10] The student linkages through time make possible the inclusion of controls for prior achievement, other aspects of unobserved student heterogeneity, and transition costs associated with changing schools. Moreover, the long panels make possible sensitivity tests on the importance of family and other shocks that may accompany a change in sector and may bias the estimated effect of charter schools.

Although the other studies have not reached a consensus, there are some similarities in the main results. In studies of charter school effects in North Carolina and Florida respectively, Bifulco and Ladd (2006) and Sass (2006) both use student fixed effects with value added estimators and find that the underperformance of charter schools diminishes the longer schools are in operation. A key difference, however, is the number of years needed to eliminate the gap. Sass (2006) finds that it is roughly three in Florida, while Bifulco and Ladd (2006) find that charter school underperformance remains even after five years. The use of achievement gain as the dependent variable in the North Carolina study as opposed to the more flexible lagged dependent variable model used in the study of Florida may contribute to the larger negative effects as might other specification differences.[11] Alternatively, actual charter school underperformance may be larger in North Carolina than in Florida.

Booker et al. (2004) also find a similar pattern for Texas public schools but attribute most of the initial underperformance to the students' inexperience in charter schools rather than the inexperience of the schools. This interpretation depends on the assumption that transition costs associated with a switch to a charter school are fundamentally different from transition costs endured by those moving among public schools. This method does not use the first year of performance in a charter school or the first year regular school achievement for those who transition from a charter to a regular public school in the identification of charter school coefficients. Thus, the estimates are based on a very select sample of persistent charter students, ones that almost certainly have a better than average charter school experience. Whether or not this approach provides informative estimates, it highlights the fundamental role of mobility in the estimation of charter school effects using panel data.

We begin with an investigation of the overall performance of Texas charter schools including the possibility that mean sector differences vary by student characteristics. We report a number of specifications that highlight the sensitivity of the estimates to controls for observed and unobserved student heterogeneity and the treatment of mobility and provide a series of specifications designed to uncover the likely importance of unobserved family or student shocks. Following the analysis of mean differences, we estimate school value added for each charter and regular public school in the sample and investigate the responsiveness of parents to this and other measures of school quality in the decision to exit a school.

[10] Booker et al. (2004), Bifulco and Ladd (2006), and Sass (2006) also use panel data methods to identify charter school effects.

[11] Rivkin (2005) illustrates the potential bias introduced in a fixed effects model such as that by Bifulco and Ladd (2006), which relies on the assumption of no knowledge depreciation across grades.

2.2. Empirical model of average charter school effects

Eq. (1) highlights the key identification issues that must be addressed in the absence of random assignment. Here achievement, A_{iGs}, for student i in grade G and school s is modeled as a function of student, family, and peer factors and an indicator for charter school attendance:

$$A_{iGs} = \alpha_{iG} + \beta X_{iGs} + \delta C_{iGs} + \lambda P_{iGs} + e_{iGs} \tag{1}$$

where C is a charter school indicator variable, X and P are vectors of contemporaneous family background and peer characteristics during grade G, α is an intercept for student i that is specific to grade G, and e is a stochastic term capturing other unmeasured influences.[12] If C were uncorrelated with α and e, OLS would yield an unbiased estimate of δ. But as noted above, the choice-based determinants of charter school enrollment and other evidence on school effects strongly suggest that typically available variables contained in X do not account adequately for potentially confounding factors. In particular, unobserved student differences between regular and charter schools could contaminate the estimates.

2.3. Unobserved student heterogeneity

The panel data enable several methods to control for student heterogeneity, the parameter (α) in Eq. (1), and the desirability of each depends on the underlying structure of learning. Because a number of student specific factors and experiences potentially determine the magnitude of α and because some of the factors vary over time and likely have effects that persist into the future, there is strong reason to believe that α evolves systematically over time.

Consider Eq. (2), which specifies α as a function of prior school, peer, and family variables, charter school attendance in previous grades, and unobserved "ability" γ.[13]

$$\alpha_{iG} = \beta\sum_{g=1}^{G-1} \theta^{G-g} X_{igs} + \varphi\sum_{g=1}^{G-1} \theta^{G-g} S_{igs} + \lambda\sum_{g=1}^{G-1} \theta^{G-g} P_{igs} + (\gamma_i + \sum_{g=1}^{G-1} \theta^{G-g}\gamma_i) \tag{2}$$

where S is quality of prior schooling including any charter school participation. This formulation captures the possibility that family background, peer interactions and school quality including charter school attendance in grades prior to G establish the knowledge base for learning in grade G and therefore affect achievement at the end of grade G.[14] The effects of prior period variables are assumed to decline exponentially as a function of time from the present at a constant rate $(1-\theta)$, where $0 \le \theta \le 1$. At the extreme of $\theta = 0$, past inputs are not relevant for current achievement, i.e., having a good fourth grade teacher does not have any implications for math achievement at the end of the fifth grade. On the other hand, $\theta = 1$ implies no depreciation of the influence of past inputs, i.e., that the impact of a good fourth grade teacher on 4th grade achievement equals her impact on

[12] A full set of cohort-by-grade fixed effects is included in all specifications to capture changes in test performance across grades and cohorts that may introduce spurious correlation between charter school composition and achievement.

[13] Boardman and Murnane (1979) and Todd and Wolpin (2003) also highlight the importance of unobserved ability and the cumulative nature of learning.

[14] This representation makes clear the interpretation of the various inputs (X, C, and P). These represent the flow of these inputs in each grade, and the cumulative inputs, appropriately weighted, provide the stock of each input up to grade G. At times these flows are measured by the contemporaneous level of inputs, particularly those that do not change frequently such as the education levels of parents. But, even then, with separation and new family relationships, these inputs can vary over time.

fifth grade achievement and achievement in all future grades. For convenience, we assume that the effects of charter school attendance and other variables decay at the same rate, although this is not essential for the development below.

The term γ captures student differences that remain constant during the schooling years including early childhood influences, prenatal care, heredity, and other systematic factors. Notice that our formulation is learning-based in that the value of γ affects the quantity of skills and knowledge acquired at each grade, and these increments to achievement are subject to depreciation. This explicitly permits the affects of ability on achievement to increase with age. The exact formulation and interpretation depends, however, on the measurement of achievement. If measured with vertically aligned tests, differences in γ would contribute to a widening of the skill distribution over time as long as θ were not equal to zero.[15] On the other hand, if skills were measured in distributional terms (as we do here with standardized scores), the complicated final term in parentheses could be replaced with γ_i, because ability induced differences in relative achievement would remain constant over time.[16]

Eq. (2) includes a mixture of time invariant and time varying individual differences that could potentially bias estimates of charter school effects. Panel data on student achievement permit a number of approaches to control for such differences including the inclusion of student fixed effects, the use of a value added specification that controls for lagged achievement score, or a combination of the two, all of which are found in the literature.[17] Importantly, some popular methods including the fixed effect in levels specification and value model with the test score gain as the dependent variable impose strong assumptions regarding the value of θ and are likely to introduce specification errors.[18]

Our preferred specification is a lagged achievement model which includes the prior grade test score as an explanatory variable.[19] This framework imposes no assumption on the value of θ, permitting prior achievement to control for the cumulative effects of observed and unobserved past experiences and ability on current achievement. Because lagged achievement may fail to capture fully all relevant student differences, some specifications also account for student fixed effects by taking first differences. As Hsiao (2002) points out, however, the inclusion of a lagged dependent variable in a fixed effects model necessitates the use of an instrument for the lagged score. Twice lagged test score provides a valid instrument for the differences on the right hand side, though this reduces the number of observations by one for each student.

An additional extension recognizes the possibility that a linear model in lagged achievement may fail to capture the full complexity of the relationship between prior inputs and achievement.

[15] In testing terms this implies having vertically scaled scores that indicate skills and knowledge over time and not just measurement relative to a grade-specific norm for learning.

[16] Note that, more generally, this holds for all time invariant factors. Consequently, if the distributions of school quality and family and community environments were held fixed before grade G, current characteristics would fully describe schooling, family, and community histories. Of course this would rule out the use of panel estimators and make it virtually impossible to identify the causal effects of specific factors. Moreover, the notion of constant school and teacher quality contradicts evidence of substantial student mobility and within school variation over time in the quality of education.

[17] With just two observations on each student, as was the case in most earlier analyses, the alternative specifications are limited, because it is not possible to include both student fixed effects and direct measures of prior achievement in the estimated models. With three or more observations, these inherent restrictions are eliminated.

[18] Rivkin (2005) describes the specification errors introduced by the assumptions of $\theta=0$ (levels model with no control for prior achievement) or $\theta=1$ (test score gain as dependent variable).

[19] Sass (2006) also uses this specification.

For example, the rate at which current learning builds upon past knowledge could vary across the skill distribution, or the structure of the available tests could lead to systematically higher gains in schools that focus on material emphasized on tests. Test structure is a particularly salient issue, because the basic tests used here and elsewhere were developed for school accountability purposes and tend to focus much more on differential learning of basic material and less on high level skills. For example, even large effects of charter schools or other factors may translate into few additional questions missed or answered for students familiar with most of the material prior to the start of the year.[20] To examine the effects of any such nonlinearities on the charter school estimates, we relax the linearity assumption on the relationship between prior and current year test scores in the value added model. Instead, we divide prior grade test scores into twenty equally sized intervals and include an indicator variable for each group.

2.4. Time varying shocks

A significant concern is that shocks to the student or family that precipitate or accompany charter school attendance could bias estimates of charter school effects. Because most Texas charters had been in operation for three years or fewer as of 2001, a substantial share of charter students moved there from regular public schools. Evidence presented by Hanushek et al. (2004) indicates that such mobility can adversely affect performance of both movers and schoolmates, even in the case of structural transitions between elementary and middle school.

A complication in the case of charter schools is the absence of a clear distinction between structural moves and family initiated moves. Transitions to charter schools share aspects of each: a residential change is not required, a student may or may not be accompanied by classmates, and the curricular structure of the new school is likely to differ from that of the previous school. Because we cannot identify all students who must change residences and because moving to middle school appears to exert a substantial transactions cost, we divide moves on the basis of whether students are moving into the first grade offered in a school or moving into a grade other than the first grade offered. The former captures the transactions costs typically associated with a structural move, and the latter is more closely related to a family initiated move.

The grouping of structural and family initiated moves also complicates estimation of the external effect of turnover on schoolmates. By construction turnover equals 100% in the first grade offered in a school, making the proportion of students who move uninformative for those years. Consequently, we define peer turnover as the proportion of students new to the school in grades for which the previous grade was available in the school.

In addition to any direct effects of the transitions on achievement, behavioral factors that precipitate charter school entry can also confound the estimates. These include a bad experience in the regular public school, decline in regular public school quality, or even a change in residence or family structure. These phenomena are very similar to the evaluation problem when there is a preprogram dip in earnings prior to entering job training.[21] Importantly, linking students over time can exacerbate the influence of such shocks. For example, a temporary negative shock in the year prior to charter school entry would reduce achievement growth in that year and increase growth in the following year during recovery from the temporary downturn. The shock and

[20] Bacolod and Tobias (2003), Hanushek et al. (2005), Tobias (2004) discuss this issue.

[21] Heckman and Smith (1999) discuss the implications of a preprogram decline for the estimation of job training program effects.

recovery, both unrelated to actual school effects, would inflate the estimated benefit of charter schools (or cost of attending a charter in the case of a temporary positive shock). Although the crude controls for family income may capture some family changes, the long panels enable an investigation of the possible effects of positive or negative shocks that precipitate a move through the use of interrupted panel estimators that exclude the year prior to the move from the analysis.[22] Any such shock and recovery phenomena would have a much smaller impact on estimates based on comparisons of performance in a charter school with performance in a regular school two years prior to entry.

A final phenomenon presents a very different concern. The opening of charter schools could push regular public schools to improve performance. This general equilibrium effect would attenuate estimates of charter school effects based on regular/charter school comparisons. Given that Texas already had a test based accountability program in place, charters may not have a large impact on regular school performance. Nonetheless, the possibility that regular schools responded and raised achievement gains thereby biasing downward the estimated charter school effect should be kept in mind, though we cannot directly address this issue.[23]

3. The UTD Texas schools microdata panel

The cornerstone of this research is the analysis of a unique microdata set of school operations constructed by the Texas Schools Project at the University of Texas at Dallas.[24] The database tracks students as they progress through school; it measures student performance each spring; and it contains detailed information about schools and teachers. This analysis follows four consecutive cohorts for the period 1996 to 2002, focusing on achievement in grades 4 through 8. For each cohort there are more than 200,000 students in over 3000 public schools eventually including over 200 charter schools.

Beginning in 1993, the Texas Assessment of Academic Skills (TAAS) was administered each spring to eligible students enrolled in grades three through eight. Unique IDs link the student records with the test data. The criteria referenced tests evaluate student mastery of grade-specific subject matter and provide the basis for our measure of student outcomes. We use mathematics and reading test scores in this paper. Because the number of questions and average percent right vary across time and grades, we begin by transforming all test results into standardized scores with a mean of zero and variance equal to one. Preliminary results for mathematics and reading were quite similar, leading us to concentrate on a composite score constructed by averaging the standardized math and reading scores for each student in each year and re-standardizing annually to yield a single achievement measure as a z-score.

[22] In our related work using similar methods, analysis of special education program effects failed to find any evidence of temporary dips or improvements prior to program entry (see Hanushek et al., 2002a).

[23] On the one hand, Hoxby (2003) suggests that charters and vouchers in other states have spurred the public schools to perform better, although the competitive effects are less clear in Arizona, a rapidly growing state like Texas. On the other hand, Bifulco and Ladd (2006) do not find that charters lead to systematic improvement of regular public schools. In addition, the Texas Center for Educational Research and others (2001) suggest from survey information that there is limited reaction of the public schools to the existence of a charter, although Gronberg and Jansen (2005) suggest at least at the high school level that competition might have improved performance in regular public schools in Texas.

[24] A more detailed description of the underlying database can be found in John F. Kain, "Description of the UTD Texas Schools Project" (2001), and other publications on the website for the UTD Texas Schools Project (http://www.utdallas.edu/research/tsp/).

The data contain a limited number of student, family and program characteristics including race, ethnicity, gender and eligibility for a free or reduced price lunch. Nonetheless, the panel feature can be exploited to account implicitly for time invariant individual effects on achievement. Importantly, students who switch schools can be followed as long as they remain in a Texas public school.

The TAAS data are merged with information on whether a school is a state authorized charter, a district authorized charter, or a regular public school. Any school without students in the TAAS data set is excluded from the sample; therefore, our number of charters will differ from public records of the number of authorized charter schools. (Note, however, that students do not have to have completed the tests to be included in the TAAS file). Also omitted are those charter schools exclusively serving children with special needs as well as those serving residents in treatment programs or disciplinary facilities.

4. Average effects of charter schools on achievement

Initial estimates of overall charter school effects on combined mathematics and reading achievement come from a series of specifications based upon Eqs. (1) and (2). For each specification, charter school effects are presented for all charters (top panel) and by years in operation (bottom panel). All specifications include lagged achievement to control for individual heterogeneity. Also included are indicators for subsidized school lunch eligibility, year-by-grade (to allow for differences in tests across years), and two mutually exclusive mobility indictors for students who switched into the first grade offered in a school (which includes structural transitions to a regular public middle or junior high school) and those who switched into a grade other than the first offered. Specifications that do not account for student fixed effects also include a vector of ethnic dummy variables (Asian, black, Hispanic and Native American) and a dummy for gender. Standard errors are adjusted for the clustering of students into schools.

4.1. Basic results

Table 2 reports the results of a series of specifications that differ by the treatment of lagged achievement, student fixed effects, and included peer variables.[25] The first three and last three columns report a parallel set of estimates from OLS and from IV techniques based on first differenced models for individual students. Each set of estimates progressively adds controls for peer achievement and turnover. The middle column (column 4) substitutes a series of dummy variables indicating prior achievement category in place of the single prior achievement variable to examine the sensitivity of the results to the assumption of linearity. The IV estimates with first differences of performance account for differential student growth as characterized by individual fixed effects.

The top panel shows that charter schools in our sample on average perform significantly worse than regular public schools. Further, the unobserved student differences tend to bias this gap toward zero: taking first differences slightly more than doubles the magnitude of the average charter school deficit, suggesting positive selection into charter schools. That is, charter students have lower achievement than the average regular public school student, but, conditional on prior

[25] The presence of a lagged dependent variable in the first differenced specifications requires the use of instrument variables in order to obtain consistent estimates. Twice lagged achievement provides a valid instrument for the first difference in prior test scores that appears on the right hand side.

Table 2
Value added of charter school attendance for composite mathematics and reading achievement (absolute value of t statistics in parentheses)

	OLS estimation of lagged achievement models				IV estimation of first difference models		
		With peer achievement				With peer achievement	
			With student turnover				With student turnover
				Non-linear lagged achievement			
Average charter	−0.10	−0.10	−0.10	−0.11	−0.23	−0.25	−0.24
	(2.62)	(2.60)	(2.53)	(2.70)	(7.81)	(7.85)	(7.60)
By years of charter operations							
1st year	−0.27	−0.26	−0.26	−0.26	−0.32	−0.34	−0.32
	(2.60)	(2.59)	(2.54)	(2.57)	(5.75)	(5.88)	(5.62)
2nd year	−0.12	−0.12	−0.11	−0.13	−0.26	−0.29	−0.28
	(2.56)	(2.52)	(2.46)	(2.66)	(7.70)	(7.88)	(7.61)
3rd year	−0.08	−0.08	−0.07	−0.08	−0.17	−0.20	−0.19
	(1.61)	(1.51)	(1.47)	(1.63)	(4.30)	(5.09)	(4.95)
4th year	0.004	0.01	0.01	0.01	−0.07	−0.08	−0.07
	(0.09)	(0.15)	(0.19)	(0.15)	(1.73)	(1.93)	(1.81)
5th year or more	0.02	0.01	0.01	0.01	−0.04	−0.06	−0.06
	(0.26)	(0.22)	(0.23)	(0.13)	(1.05)	(1.35)	(1.35)
Observations	3,673,040				2,557,626		

Note: All specifications include a full set of grade by year dummy variables, lagged student achievement, and indicators for subsidized lunch eligibility, a move to a new school in the first grade offered, and a move to a new school in other than the first grade offered. The basic OLS lagged achievement models also include indicators for race and ethnicity and gender. The first differenced models are estimated using IV with twice lagged achievement as the instrument for the difference in lagged achievement. The first differenced models account for student fixed effects.

achievement level, those going to charter schools progress more rapidly in terms of academic achievement than those who remain in regular public schools.

The two estimation approaches rely upon different identification of the charter school effects. The OLS estimates use comparisons, adjusted for individual characteristics, between students in regular public schools and in charter schools, while the first differenced estimator identifies the charter school parameter entirely from achievement changes for students who move into or out of charter schools. As the table indicates, despite controls for mobility, race and ethnicity, income, and prior achievement, regular public school students appear to provide a poor counterfactual for students in charter schools.

The estimates also reveal that peer composition accounts for little if any of the quality gap in either the basic achievement models or first differenced specifications. The successive inclusion of peer average achievement in the prior grade and the proportion of students who are new to the school has virtually no impact on coefficient magnitudes. In addition, the exclusion of the student move variables also has virtually no effect. Thus the substantial sector differences in mobility and average peer achievement explain little of the charter school deficit.

To investigate the potential impact of years of charter operation on charter school quality, specifications reported in the lower panel of Table 2 replace the single charter school treatment variable with a series of dummy variables indicating the age of the charter school. The results

Table 3
Alternative estimates of the returns to charter school experience (absolute value of t statistics in parentheses; 3,673,040 observations)

Years of charter operation		With school fixed effects	
1st year	−0.26	−0.20	−0.19
	(2.54)	(5.86)	(5.38)
2nd year	−0.11	−0.09	−0.07
	(2.46)	(2.99)	(2.27)
3rd year	−0.07	0.01	0.03
	(1.47)	(0.44)	(1.00)
4th year	0.01	0.07	0.08
	(0.19)	(2.43)	(2.82)
5th year or more	0.01	Omitted	Omitted
	(0.23)		
Teacher Experience			
Proportion 0 years			−0.09
			(34.24)
Proportion 1 year			−0.03
			(11.67)
Class size			−0.0015
			(17.2)

Note: Column 1 of this table is identical to column 3 of Table 2, and the remaining columns are based on this specification.

show that the inferior performance of charter schools is concentrated among schools in their first three years of operation and that the deficit is much smaller (and no longer statistically significant) in the fourth and fifth year.[26]

Although these results suggest that schools improve with longer operational life, an alternative possibility is that the charter age coefficients capture quality differences by vintage rather than experience. In order to distinguish among these two explanations, Table 3 reports results from specifications that control for such differences by vintage with school fixed effects. Because of the computational difficulties involved in estimating first differenced specifications that contain school fixed effects, we present only the results for the OLS specifications. Note, however, that the school fixed effects capture any student differences that vary systematically by school in addition to all other fixed school differences.

The results in Table 3 provide strong support for the notion of substantial learning by school operators in their early years of operation. The coefficients on the first and second years of operation dummies are statistically significant and roughly 75% as large as the coefficients from similar specifications without school fixed effects, while the coefficients on the third and fourth year dummies become more positive.

Table 3 also presents evidence on potential sources of the start-up difficulties, particularly the possibility that teacher inexperience in new charter schools may contribute to their lower effectiveness. Because past analyses suggest that teacher learning is concentrated in the first two

[26] Many school districts in Texas are growing and thus adding new schools. For these regular public schools, we could calculate their years of operation, but that would have a very different meaning than the measure for charter schools. New regular public schools enter an operational district with existing curricula, hiring policies, business services, and the like. In comparison, charter schools are most frequently entirely new single-school start-ups with none of the existing infrastructure and operating procedures.

Table 4
Marginal differences of average charter school value added by race/ethnicity, Income, and initial achievement (absolute value of *t* statistics in parentheses; 2,557,626 observations)

	With single indicator for charter schools	With separate indicators for years of charter operation
By race/ethnicity		
Black	0.00	−0.01
	(0.07)	(0.15)
Hispanic	0.08	0.10
	(1.25)	(1.46)
By income		
Eligible for subsidized lunch	0.03	0.04
	(0.73)	(1.10)
By initial achievement		
Bottom third	−.16	−.14
	(3.8)	(3.7)
Middle third	−.09	−.08
	(3.06)	(2.73)

Note: Separate regressions for each category are estimated using IV techniques for first difference value added form. Coefficient relates to an interaction term for each variable with an indicator for charter school. Specifications include variables in final column of Table 2.

years on the job, we focus on the shares of teachers with 0 and 1 year of experience.[27] Thirty-one percent of charter school students have teachers have one or zero years of experience in Texas public schools compared to less than 14% of students in regular public schools. The inclusion of experience measures along with average class size does lead to small reductions in the magnitudes of the coefficients on the first and second year indicators for charters, though smaller class size in charter schools (an average of roughly 3 students per class lower) offsets a portion of the cost of teacher inexperience.[28] Nonetheless, the vast majority of the poor performance of new charters remains unexplained.

If lower income, minority, or initially lower achieving students disproportionately attend lower quality public schools, one might expect these students to enjoy larger benefits from charter school attendance.[29] We investigate this possibility by adding interaction terms between charter school attendance and demographic group. The results from first differenced specifications reported in Table 4 provide little support for this view. The average effects of charter school attendance are less negative for lower income, black, and Hispanic students, but the interaction coefficients do not approach statistical significance regardless of whether specifications combine all charters or disaggregate by years of charter operation. In contrast, children in the bottom third initial achievement category fare the worst in charters, next come those in the middle third, and finally those in the upper third experience the least negative effect on average of −0.14. This pattern is consistent with initially higher achieving children experiencing less disruptive transitions or smaller decreases in average instructional quality.

[27] See, for example, Rivkin et al. (2005) or Rockoff (2004).
[28] Although concealed by rounding to two decimal places, the decrease approaches 0.02 for the coefficient on charters in their first year.
[29] This is similar to the finding that Catholic schools are superior to public schools in central cities but not suburbs (Neal, 1997).

4.2. Sensitivity analysis

A central concern is that unmeasured changes in personal well-being or the family environment (captured in ε_{iGs} in Eq. (1)) are systematically related to the decision to enter or exit a charter school. As noted above, a temporary downturn in academic performance that triggers entry into a charter but that is subsequently reversed will bias estimated charter school quality upward because it induces a positive covariance between the charter treatment and the error, with the bias being larger in the first differenced specifications. A trend toward decreasing or increasing annual achievement among students entering charters would also bias first differenced estimates of the benefits of charter school attendance, though the direction of bias would depend upon both the direction of the trend and the sequence in which students transition between sectors.

Even in the absence of any such changes, the decision to transfer depends on both the quality of the specific charter or traditional school and the match quality of the student with the school. This is particularly important in the case of students exiting charter schools who are likely to have attended lower quality charters than the average student.[30]

We examine a series of additional specifications to understand the magnitude of these potential biases. First, we separate transitions into charter schools from transitions out of charter schools, generating two different estimates of the charter-regular public school differential. Second, to evaluate the importance of either temporary shocks associated with charter school entry or trends in unobserved achievement determinants, we compare interrupted panel estimates of charter school quality based on achievement differences between the first year in a charter and the penultimate year in a regular public school with estimates based on achievement differences between the first year in a charter and the final year in a regular public school for the sample of students observed for at least two years in a regular public school.[31]

Table 5 reports separate charter school coefficients for entrants and exits. The much more negative charter school coefficient for exits in Table 5 fits with the notion that those who exit charter schools have had a worse experience in the charter school than the typical charter school student. Even students who exit older charter schools fare significantly better upon returning to a traditional public school.[32]

Finally, the interrupted panel estimates in the final two columns of Table 5 provide little support for the view that either temporary shocks coinciding with charter school entry or permanent trends in the rate of learning introduce substantial bias.[33] The similarity of results from

[30] These issues and sensitivity analyses are similar to those described in Hanushek et al. (2002a) in the context of special education.

[31] Consider a student whose rate of learning declines in grade 6 in comparison to grade 5 and transfers to a charter school in grade 7. In the case of a temporary negative shock limited to grade 6, the lower grade 6 test score biases the first differenced estimate of the benefits of charter schools upward, because the grade 6 score serves as the pretest for grade 7. Notice that the magnitude of the bias is much larger if the coefficient is identified from achievement comparisons for grades 7 and 6 than if it is identified from achievement comparisons for grades 7 and 5. In the former case the negative shock deflates achievement while in the regular public school but in the latter case it does not. In the case of a permanent downward trend in the rate at which a student learns, achievement in grade 7 would fall below achievement growth in grades 6 and 5 even in the absence of any change in school quality. Here the adjacent year comparison would produce less bias than an estimate based on the comparison of achievement in grades 5 and 7. Regardless of the direction of the trend, the difference between estimates based on adjacent grades and those based on non-adjacent grades would provide evidence on the magnitude of any such permanent trends.

[32] Below we estimate the sensitivity of exit decisions to school quality. Quality differences may exist both between and within schools. Rivkin et al. (2005) identify substantial variation in teacher quality within schools.

[33] For this analysis, we rely on a consistent sample limited to students who do not change sectors and charter school entrants with at least two observations prior to entering a charter.

Table 5
Sensitivity tests for estimates of charter school value added (absolute value of *t* statistics in parentheses)

	By school sequence for sector switchers:		By regular school comparison for charter school entrants:	
	Regular to charter	Charter to regular	Year prior to entry	Two years prior to entry
Average charter	−0.19	−0.39	−0.18	−0.20
	(4.95)	(11.51)	(4.88)	(4.02)
By years of charter operation				
1st year	−0.28	−0.52	−0.27	−0.32
	(4.00)	(10.45)	(4.82)	(4.10)
2nd year	−0.24	−0.41	−0.21	−0.23
	(5.37)	(10.01)	(4.04)	(3.74)
3rd year	−0.16	−0.28	−0.14	−0.15
	(3.34)	(5.62)	(2.87)	(2.60)
4th year	−0.05	−0.18	−0.06	−0.06
	(1.00)	(3.52)	(1.17)	(1.10)
5th year or more	−0.03	−0.09	−0.08	−0.06
	(0.55)	(1.15)	(1.50)	(1.00)
Observations	2,556,159	2,553,183	2,551,010	

Note: Separate regressions for each column are estimated using IV techniques for first difference value added form and contain the variables included in the specification reported in Column 6 of Table 2. Estimates reported in the final two columns come from a common sample of students who do not switch sectors and charter school entrants with two observations in regular public school prior to switching to a charter school. Any additional years in public school prior to these two are excluded from the sample.

a sample that includes only the public school observation two years prior to entry and a sample with the same students that includes only the public school observation immediately prior to entry is striking (−0.20 to −0.18).

5. School heterogeneity and parental decision making

The conceptual arguments under girding charter school reform efforts are directly adapted from the original arguments of Milton Friedman for support of voucher schools (Friedman, 1962). Developing competitive markets for schooling would offer alternative types of schools that better meet consumer desires, would foster innovation and the introduction of alternative pedagogies and curriculum, and would lead to more efficient supply through competition of schools for students. But, while picking up the conceptual arguments for more choice, charter schools also pick up the arguments against.[34] One persistent assertion is that parents, and particularly low-income parents, are likely to be poor consumers of quality — perhaps because of informational problems, lack of attention, lack of experience, or the complexity of the problem given the time until the results can be fully observed. To investigate the responsiveness of parents to school performance, we analyze the effects of school quality on the parental decision to exit a school.

The charter schools that have developed follow a wide variety of principles and conceptual models, including simply “doing better” than the regular public schools, providing alternative

[34] Charter schools avoid the argument that the competitive schools would only seek profits and would not serve society’s interests. An appeal of charter schools is that they are fully under public control.

curricular and pedagogical focus, emphasizing discipline or moral values, developing the arts, and the like. These alternatives may not map simply into measured student achievement, and, as such, consumers with different preferences may well be making optimal choices based on private criteria — even if their charter schools do not exceed the regular public alternative in terms of math and reading performance.

Nevertheless, in designing their testing and accountability systems, the State of Texas has made higher achievement a primary objective of public education, leading us to investigate how school performance on state accountability tests enters into parental decision making. Since 1991, the state has published its Academic Excellence Indicator System (AEIS). This system has evolved over time, but now includes ratings of performance by school and disaggregated student groups that are based on a combination of all available student test scores, dropout and attendance rates, and other performance information. The ratings of schools (academically unacceptable, academically acceptable, recognized, or exemplary) receive considerable public attention with highly ranked schools advertising their position quite widely.[35] These ratings are based on the shares of students exceeding specified achievement thresholds or, in the case of the acceptable or recognized levels, by the change in annual achievement relative to required improvement standards.[36] Importantly, student performance is not adjusted for background differences, and substantial achievement variation remains with rating categories.

We do not know how parents make judgments about school quality or which factors parents use in making their school exit decisions, and therefore we examine parental responsiveness to four different measures of school academic performance. These are 1) the Texas accountability rating (AEIS) for each school; 2) our estimate of school value added to mathematics and reading achievement; 3) a measurement error adjusted (shrunk) estimate of school value added; and 4) the average achievement in math and reading in the school. These differ substantially from one another. While the value added measures we develop control in varying ways for student differences among schools, the state rankings do not. Additionally, the statewide accountability measure also depends on factors other than mathematics and reading achievement and considers some elements of school progress. Note that the state ratings are typically released just prior to the start of school, which may impose limits on their usefulness for parents deciding whether to remain in the school.

5.1. Measurement of school quality

We define school quality in terms of the value added of schools, and the estimates of school value added follow directly from our previous analysis. Specifically, we use lagged achievement specifications similar to those used in the analysis of sector average differences but substitute separate dummy variables for each regular public school and for each charter school by year combination in place of the overall charter school dummy variables. The coefficients on these dummy variables measure school quality in terms of value added to achievement, controlling for observed student and community characteristics including student and school average

[35] As noted below, some schools are also unrated because of their special nature or because of insufficient student performance data.

[36] A description of the ratings can be found in Table 6 in the 2005 Accountability Manual (www.tea.state.tx.us/perfreport/account/2005/manual). For years until 2001/02 school year, the state developed a "comparable improvement index" that ranked each school's change in test score over time against that for forty schools comparable on demographic characteristics. This information was available on the Texas Education Agency website, but has not been produced in recent years.

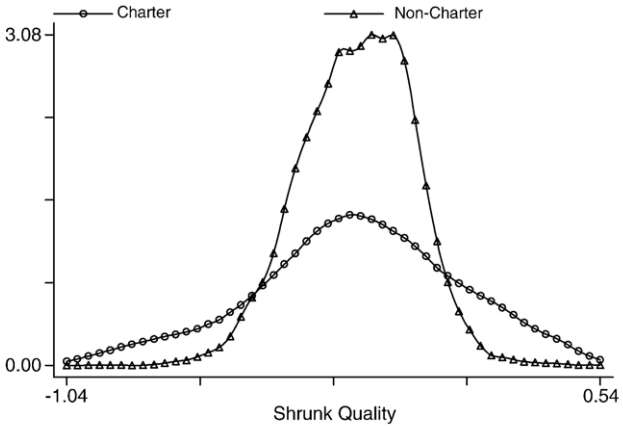

Fig. 2. Distribution of adjusted value added measures for charter and regular public schools.

demographics, peer achievement, and student turnover. In addition, the inclusion of separate dummy variables for each year a charter operates captures the substantial effects of initial experience on charter school quality.

In the prior estimation of average sector differences, the possibility that lagged achievement fails to control adequately for student heterogeneity led us to employ student fixed effects, and similar concerns arise in the measurement of school value added. However, the estimates of quality for each charter school would then depend upon the small numbers of students who transfer from each school, likely leading to highly variable estimates. Moreover, the addition of thousands of school fixed effects to the first-differenced model with instrumental variables imposes a daunting computational burden.[37] Consequently, we do not estimate school quality from models that include student fixed effects, and rely on the assumption that any unobserved differences among students in the propensity to exit a charter or regular public school are not systematically related to unobserved student effects on each quality measure within the respective sectors.

An important consideration is the degree to which the variation represents actual differences in school quality as opposed to pre-existing differences in student knowledge or test measurement error. As Kane and Staiger (2002) and Jacob and Lefgren (2005, 2006) point out, even in the absence of confounding influences, school quality estimates capture both random error and true effects of schools. Importantly, such noise may attenuate the estimated responsiveness to actual school quality. Following Morris (1983), we utilize a shrinkage estimator to mitigate the potential impact of the test error and to provide a specification test on our basic estimates. The adjusted school quality estimate $\hat{\eta}_s^a$ for school s in year y is:

$$\hat{\eta}_{sy}^{a} = \left(1 - \frac{V_{sy}}{V_{sy} + \hat{\sigma}^2}\right)\hat{\eta}_{sy} + \frac{V_{sy}}{V_{sy} + \hat{\sigma}^2}\,\bar{\eta}_g$$

[37] Abowd et al. (1999) proposed IV methods to circumvent the need to estimate models with both student and school fixed effects, but we do not have any conceptually valid instruments in the data. Our own attempts at direct estimation failed to generate usable estimates of school value added despite a variety of attempts to simplify the data structure and model estimation.

Table 6
Distributional information on AEIS categories versus quartiles of other school aggregate measures and by sector

Quartile	Measure	AEIS Category					
		Unrated (%)	Unacceptable (%)	Acceptable (%)	Recognized (%)	Exemplary (%)	Total (%)
I	Unadjusted VA	1.1	2.5	64.3	25.2	6.9	100.0
(0–25%)	Adjusted VA	1.1	2.5	64.0	25.5	7.1	100.0
	Levels	1.1	3.8	83.9	10.6	0.6	100.0
II	Unadjusted VA	0.2	0.9	49.1	33.6	16.2	100.0
(26%–50%)	Adjusted VA	0.2	1.0	49.5	33.1	16.2	100.0
	Levels	0.1	0.3	59.5	35.7	4.4	100.0
III	Unadjusted VA	0.1	0.7	40.9	34.3	24.1	100.0
(50%–75%)	Adjusted VA	0.1	0.6	41.0	34.5	23.8	100.0
	Levels	0.2	0.1	32.6	50.4	16.7	100.0
IV	Unadjusted VA	0.1	0.2	33.6	35.6	30.6	100.0
(76%–100%)	Adjusted VA	0.1	0.2	33.4	35.7	30.7	100.0
	Levels	0.1	0.0	11.9	32.0	56.0	100.0
By sector							
Charter		27.8	20.5	31.8	9.3	10.6	100.0
Non-charter		0.2	0.9	47.1	32.3	19.5	100.0

where $\hat{\eta}_{sy}$ is the coefficient on the school s dummy variable (in year y for a charter school), V_{sy} is the estimated variance of that estimate, $\widehat{\sigma^2}$ is the estimated variance of the regular public school or charter school-by-year fixed effect distribution, and $\overline{\eta}_g$ is the mean fixed effect within charter or non-charter group as applicable.[38] Essentially, the larger the fixed effect error variance for a school the more the estimated school fixed effect is shrunk toward the sector mean.

Not surprisingly, this adjustment has a larger impact on the charter school distribution, since these schools tend to be smaller than the regular public schools and thus are prone to more estimation error. The charter school standard deviation falls from 0.34 to 0.29 with the shrinkage estimator, while the regular public school falls from 0.14 to 0.13. Importantly, substantial variation remains in both sectors. Fig. 2 presents kernel density plots of the adjusted, or shrunk, school value added estimates which reveal substantial differences both within and between sectors.

Table 6 reports the association between these value added measures, school average achievement (which was plotted in Fig. 1) and the AEIS rating. Although the correlations between the value added and achievement measures approach 0.5, the AEIS ratings are much more strongly ordered by level of achievement than by value added, not surprising given the algorithm used to generate the ratings. The differences between our value added measures (which we believe to be more reliable indices of school quality) and the state ratings is especially dramatic. Almost one quarter of the bottom half of schools in terms of value added are rated exemplary. The share of schools rated exemplary in the top quarter of the relevant distribution is roughly twice as large (56%) for average achievement as for value added (31%).[39]

[38] The very large number of schools precludes the direct estimation of the error variances of the school fixed effects. Consequently, clustered bootstrapping ensuring that each school-by-year combination has the same number of observations in each of the 50 resamples as that occurring in the full sample is used to estimate the variances of the school fixed effects.

[39] This divergence of ratings based on levels and on value added is very similar to findings about accountability systems that are based on average achievement. Because average achievement includes family background and peer effects, it is not an accurate measure of the quality of the school.

5.2. Baseline results

Table 7 reports a series of school exit regressions using the four alternative quality measures and including only students whose schools offer the subsequent grade.[40] All models include student and peer demographic characteristics in addition to the school quality measures that are the focus of the analysis.[41] Because the probability of exit depends on quality relative to alternative schools, we also include the average quality of the local public school for students attending a charter.[42] Finally, own test score gain is included to disentangle responses to school quality from potentially confounding influences that affect achievement and the probability of exit. In all cases, the impact of quality on exits is permitted to vary by sector; the charter school coefficient is parameterized to give the differential impact over that for regular public schools. *t* statistics are computed from robust standard errors clustered by school.

The estimates in Column 1 show that the state provided AEIS rating is significantly related to the probability of exit in the expected direction for both regular and charter schools, though the effect sizes tend to be much larger for students attending charter schools. Interestingly, the effect of an unsatisfactory rating is much stronger than that of a recognized or exemplary rating for regular public schools, while the opposite is the case for charter schools. The unrated category is used for a variety of special schools (juvenile justice, special education, and the like) and for schools with too few students taking tests. The fact that an unrated designation has no effect on the probability of exit for charter schools is not surprising given that it almost always indicates a first year school in the charter sector rather than a more serious problem.

The coefficients on the value added quality measures reported in Columns 2 and 3 show that charter school exit rates are strongly related to a school's effectiveness at raising achievement: a movement up the charter school quality distribution of one standard deviation (unadjusted) would lower the probability of leaving by roughly 10 percentage points or one-quarter of the baseline exit rate of 40%.[43] Importantly, the quality coefficients are not sensitive to the inclusion of own gain, alternative regular school quality, or any of the other peer variables.

Columns 5–7, which combine the AEIS ratings with value added, show that there are independent impacts of the two quite different types of measures on charter school exit rates. Parents appear to respond both to the AEIS ratings (or information related to the level of achievement such as demographic characteristics of the students) *and* to school value added despite the general absence of any published information on school effectiveness at raising scores.

In contrast to the charter sector, the value added measures are positive and significantly related to the probability of exiting a regular public school, though similar to the AEIS coefficients the magnitudes are far smaller than those for charter schools. The muted exit response of students in

[40] Logit models produce an identical pattern of results to the linear probability models.

[41] Student demographics are captured by a vector of indicator variables for student ethnicity, mobility status, gender, and family income, while peers are characterized in terms of peer average achievement and a set of school demographic composition variables.

[42] The quality of the alternative public school is calculated from those students who attended a regular public school prior to entering the charter. Average quality or the distribution of ratings based on the current year's data for the relevant sending schools is subsequently assigned to all students in the charter that year. If a charter school student transitioned from an elementary school but is currently in a middle school or junior high school grade, the quality of the middle school attached to the sending elementary school is used.

[43] The estimated impact with the adjusted value added measure is slightly smaller, but the pattern remains identical. The hypothesis that the effect of quality on the probability charter school students exit equals zero is rejected at the 1% level in all specifications.

Table 7
Estimated impact of different measures of school quality on exit probabilities (linear probability models; absolute values of *t* statistics with robust standard errors in parentheses)

School quality measure							
	AEIS Rating	School value added	Adjusted school value added	School average test score	School value added	Adjusted school value added	School average test score
AEIS rating category							
Unrated	0.08				0.08	0.08	0.07
	(2.17)				(2.23)	(2.23)	(2.15)
Unrated* charter	−0.07				−0.12	−0.12	−0.07
	(1.10)				(2.02)	(1.97)	(1.27)
Low performing	0.04				0.04	0.04	0.04
	(2.12)				(2.47)	(2.48)	(2.35)
Low performing*charter	−0.02				−0.06	−0.06	−0.06
	(0.43)				(1.24)	(1.22)	(1.34)
Recognized	−0.01				−0.01	−0.01	−0.01
	(2.35)				(3.52)	(3.57)	(2.85)
Recognized*charter	−0.07				−0.06	−0.06	−0.02
	(1.83)				(1.26)	(1.24)	(0.14)
Exemplary	−0.01				−0.02	−0.02	−0.01
	(2.44)				(3.61)	(3.04)	(2.98)
Exemplary* charter	−0.16				−0.13	−0.16	−0.05
	(3.84)				(3.17)	(3.04)	(0.94)
Alternative quality measure		0.06	0.07	0.01	0.08	0.09	0.02
		(3.54)	(3.6)	(0.9)	(4.72)	(4.79)	(2.56)
Alternative quality measure*		−0.28	−0.31	−0.14	−0.26	−0.28	−0.14
Charter school		(4.17)	(4.15)	(3.62)	(4.38)	(4.28)	(3.34)

Note: All specifications include a full set of grade by year dummy variables, own gain, own gain interacted with charter school, average quality of the alternative regular public school, indicators for subsidized lunch eligibility, a move to a new school in the first grade offered, a move to a new school in other than the first grade offered race and ethnicity, and gender, and school proportion Asian, black, Hispanic, Native American, and eligible for a subsidized lunch, and peer average achievement. The rows for "alternative quality measure" provide coefficients for school value added, adjusted school value added, or school average test score as indicated by the column heading.

regular public schools almost certainly results in part from the much higher transactions costs typically associated with moving. In fact, results from multinomial logit specifications (not shown) indicate that by far the largest and most significant differences between charter and regular school responsiveness to quality occurred for students moving to a regular public school.[44] With fixed attendance zones, parents of students in regular public schools usually have to change residences in order for their child to attend another public school, while children in charter schools can opt back into the regular public schools without having to move.

At this time the relatively small number of existing charter schools do not provide viable alternatives for all public school students. Therefore, transaction costs are much higher for most students in regular public schools who desire to change schools.

[44] The multinomial logit models separate the exits into students moving to regular public schools, moving to charter schools, or leaving the Texas public schools (which includes both moves to private schools or leaving the state). Results of this analysis are available from the authors.

Table 8
Estimated effects of test score based measures of school quality on the probabilities of exiting charter and regular public schools by family income (absolute values of t statistics with robust standard errors clustered by school in parentheses)

	School value added	Shrinkage estimator of school value added	School average test score
School quality	0.04	0.05	−0.003
	(2.25)	(2.31)	(0.36)
School quality * low income	0.03	0.03	0.02
	(2.39)	(2.51)	(3.17)
School quality * charter	−0.31	−0.33	−0.17
	(4.08)	(4.07)	(5.20)
School quality * low income * charter	0.07	0.08	0.06
	(0.96)	(0.97)	(1.55)
Own gain	−0.01	−0.01	−0.01
	(20.57)	(20.62)	(19.74)
Own gain * Charter	0.01	0.01	0.01
	(1.16)	(1.16)	(0.58)
Own gain * low Income	−0.003	−0.003	−0.003
	(4.64)	(4.67)	(5.26)
Own gain * low income * charter	−0.003	−0.003	0.002
	(0.18)	(0.20)	(0.16)

Note: These specifications include the same variables as the specifications reported in Table 7. The rows for "school quality measure" provide coefficients for school value added, adjusted school value added (with shrinkage estimator), or school average test score as indicated by the column heading.

5.3. Differences by income

Discussions of school choice frequently raise questions about equity. It is often asserted that choice will lead to wider disparities in achievement because low income families on average are less informed consumers of school quality, place less emphasis on education, or lack the connections and political savvy to get their children into the best schools. Table 8 investigates this possibility by allowing different exit responses for low income families (i.e., those eligible for free or reduced price lunch). The results provide little or no evidence of systematic differences by family income in the relationship between the probability of exit from a charter school and either school value added or AEIS rating (not shown). The differences in responsiveness to school value added by income are all insignificantly different from zero. Thus these results provide little support for the fear that lower income parents may have more difficulty acquiring the requisite information on school quality, though it is important to recognize that charter school families are not randomly drawn from the entire school population.

6. Conclusions

Charter schools have become the primary means for introducing additional choice and competition into the system of publicly supported elementary and secondary education. These schools enjoy enormous popularity as witnessed by the rapid growth of the number of charter schools in many states. Yet, although charter schools may satisfy family preferences regarding various aspects of the education environment, there has been little in the way of solid evidence regarding the academic quality of charter schools in comparison to the local public school alternative.

The results in this paper show that charter schools often have a rough beginning. Their performance (measured by average value-added) typically begins below that of regular public schools in the early years of operation, even after allowing for the selective nature of the student population. But, by the fourth or fifth year of operation there are not significant sector differences. Of course this start-up phase leads to some uncertainty, as greater numbers of students exit charters than comparable regular public schools, and this feeds back to make the start-up task even more difficult. Nonetheless, surviving charters perform similarly to regular public schools on average, suggesting that regulatory judgments should not be made too early.

As is the case with regular public schools, charter schools display considerable heterogeneity in terms of performance that is independent of their length of operation. In many respects, it is this heterogeneity that should be the focus of policy attention rather than the small difference in means of the two distributions. Finding ways to retain and expand the proportion of high performing schools and to eliminate or transform the bottom performers – whether charter schools or regular public schools – would yield an upward shift in average student performance and is likely to have a larger payoff than policies that follow from considerations of just mean differences in the two distributions.

In this regard, the competitive pressures facing charter schools and those brought to bear on existing regular public schools underlie the conceptual appeal of charter schools. A charter school will survive only if it can attract and retain students. Importantly, the findings that charter school parents respond to school effectiveness bodes well for the possibility of an education market that systematically favors higher quality schools. But it is not sufficient to ensure effective market discipline. A successful education market also requires the families of prospective students to be able to judge the quality of charter schools, because, if new entrants tend to replace all those exiting, the pressure to perform is significantly lessened. At this point we have little direct knowledge about the ability of outsiders to evaluate charter schools or whether this evaluation changes with length of operation by a charter. With regard to entry decisions, however, the divergence between school effectiveness and the AEIS ratings and the timing of dissemination of ratings to the public seems particularly important, since the ratings are likely to have a much larger impact on outsiders who lack intimate knowledge of school operations.

The mean performance results, which indicate that the average charter school is not superior to the average regular public school, can be viewed from two very different perspectives on charter school policy. Some have suggested that, if not significantly better in producing achievement gains, charters should be eliminated or at least their expansion should be slowed and they should be further regulated. Particular policy attention is given to the bottom tail of the charter distribution with calls for quick and decisive charter revocation for these schools. Others who call for the elimination of charters are interested parties who appear to be responding to the competitive pressures that charters are generating — pressures that should be reinforced and not weakened.

Yet it is precisely the poor performance and inertia of large numbers of regular public schools that provide much of the impetus for the growth of the charter sector, and the protection of the status quo does not provide an attractive policy choice. The negative relationship between the probability of exiting and school quality indicates that charter school parents do place pressure on schools by withdrawing their children in response to poor quality. This may be reinforced by improving the quality of school performance information disseminated, and one would expect the dissemination of better information and growth of the charter sector to place increasing pressure on regular public schools.

Of course knowledge shortcomings surrounding the still recent innovation of charter schools contribute to the ongoing debate over the value of this type of public school choice. Of particular importance is the lack of information on long term effects: How will the quality distribution of mature charter schools look? Will parental decision making be sufficient to eliminate poor quality charter schools? Will public schools respond to competitive pressures? What drives the supply of charter schools, and how is supply affected by the various regulations and restrictions on them? These important questions remain largely unanswered, and understanding the longer run dynamic outcomes will require some patience, a rare attribute in school policy discussions.

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