

The Evolution of Charter School Quality

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Final version received 26 October 2018.

Studies of the charter sector typically compare charters and traditional public schools at a point in time. These comparisons are potentially misleading, because many charter-related reforms require time to generate results. We study quality dynamics among charter schools in the State of Texas from 2001 to 2011. School quality in the charter sector was initially highly variable and on average lower than in traditional public schools. However, exits, improvement of existing charter schools, and higher quality of new entrants increased charter effectiveness relative to traditional public schools despite an acceleration in the rate of sector expansion in the latter half of the decade. We present evidence that reduced student mobility and an increased share of charters adhering to No-Excuses-style curricula contribute to these improvements. Although selection into charter schools becomes more favourable over time in terms of prior achievement and behaviour, such compositional improvements appear to contribute little to the charter sector gains. Moreover, accounting for composition in terms of prior achievement and behaviour has only a small effect on estimates of the higher average quality of No Excuses schools.

INTRODUCTION

Charter schools are an increasingly popular alternative to traditional public schools for families in many districts. Since the time when many of the US state laws establishing charters were passed in the 1990s, the number of schools has grown exponentially; charter schools now operate in nearly every large US city, and they educate a growing share of public school students. Although the exact character differs by state, charter schools are hybrids of public and private institutions that allow independent development and decision-making in publicly financed schools operating under the auspices of some form of public oversight. Charter schools are funded by state and local governments but are typically exempted from many state and local regulations. Proponents of charters hail the introduction of these schools as a key factor in unlocking the operation of market forces in educational markets. In their view, these schools facilitate greater school choice for parents and their children in addition to serving as potential centres for innovation in educational practices. The policy question is whether these market forces foster the emergence of higher-quality schools and better student outcomes.

The rapid expansion of the charter school sector, however, remains controversial in part because of mixed evidence on academic achievement effects. Although lottery studies focusing on oversubscribed urban charter schools have generally found positive impacts on achievement,¹ observational studies focusing on all charter schools in a geographic area, not just those that are oversubscribed, have tended to find much smaller or even negative impacts.² Reconciling this conflicting evidence has proven difficult in part because of differences in the methods used to estimate charter effectiveness. Minimal focus, to this point, has been directed at the cross-sectional nature of many of the existing

analyses. Charter schools have been introduced in many educational markets only recently, and deeper understanding of the consequences of this market-oriented reform requires examination of the longer-term dynamics of behaviour and outcomes.

Although little comprehensive research exists on the role of market forces driving the evolution of charter school quality, two studies provide evidence consistent with market forces pushing schools to improve.³ First, Hanushek *et al.* (2007) show that higher school value-added increases the probability of re-enrolment in charter schools, suggesting that households respond to quality. Second, the Center for Research on Education Outcomes (CREDO) (2013) finds that, although the mean effectiveness of Texas open-enrolment charters relative to the traditional public school (TPS) comparison group still lags the nation as a whole, charter school effectiveness has improved relative to the TPS group in a number of other states. Importantly, CREDO (2013) highlights the contribution of the closure of poorly performing charter schools to these observed improvements.

This paper contributes new evidence to this debate by capitalizing on detailed longitudinal data on students and schools in Texas, one of the largest charter school states. It has two principal aims. First, it describes how the distribution of charter school quality evolved between 2001 and 2011, focusing on the role of entry, improvement, voluntary closures, and authorizer intervention. Second, it investigates the extent to which fundamental observable factors such as student mobility, student selection into and out of charters, and the share of schools that adhere to a ‘No Excuses’ philosophy, are related to these quality improvements.

Our descriptive analysis of the dynamics of charter effectiveness in Texas provides evidence that charter school quality increased substantially over time due to both the dynamics of school entry and exit, and school improvement. Regardless of whether we compare the value-added measures of charter schools with those of all Texas traditional public schools, or estimate charter school effectiveness relative to local comparison schools using a matching approach similar in spirit to that used by Angrist *et al.* (2013), the results show improvements in both mathematics and reading value-added. A substantial portion of this improvement can be attributed to several dynamic features of the sector: voluntary and involuntary closure of underperforming schools, the increase in the quality of new entrants, and the improvement of existing schools. More specifically, similar to the findings in CREDO (2013), schools that closed prior to 2011, either voluntarily or following state authorizer intervention, were drawn disproportionately from the lower end of the quality distribution, and their closures are strongly related to the overall improvement in aggregate charter effectiveness. Further, charter schools that opened after 2001 and remained in operation in 2011 have an average value-added that far exceeds that of charter schools that closed over the same period. Finally, average value-added increased among those charter schools that remained open throughout the decade. These sectoral dynamics combine to raise the mean and reduce the variance of charter school value-added relative to traditional public schools.

We study both the distribution of quality across charter schools and enrolment patterns. At first glance, improvements in the distribution of achievement for charter-sector students failed to keep pace with the rightward shifts in the distribution of charter school value-added. However, focusing on charter schools after their first year of operation reveals a close tracking of the distributions of school value-added unweighted by enrolment and the corresponding enrolment-weighted value-added distributions. These results are consistent with a rapid expansion of the sector, including the opening of

many new schools with unknown quality, which weakens the short-run association between school quality and enrolment.

Next, we study the role of several factors in driving measured increases in school quality: the increasing share of schools adhering to a No Excuses philosophy, a decline in student turnover, and changes in the composition of charter school enrollees. Our evidence suggests that the increasing share of charter schools adhering to a No Excuses philosophy contributes to observed improvements in the sector. In addition, a decline in student mobility, largely unstudied in this context, appears to contribute substantially to the improvement of the sector as well. Finally, we present evidence of increasingly positive selection on prior achievement and behaviour among students enrolling and remaining in charter schools. Although student composition contributes to the gain in charter school quality, the findings on No Excuses schools remain in line with existing evidence (Angrist *et al.* 2013; Dobbie and Fryer 2013). Specifically, the inclusion of the mobility and selection variables reduces slightly the estimated magnitude of the No Excuses effect, but its coefficient remains highly significant in all mathematics specifications and almost all reading specifications. This finding in concert with the results on student mobility highlights the importance of patience in understanding the effects of a large-scale reform that opens the education sector to many new entrants of variable quality and that precipitates extensive switching among schools.

We begin with a brief overview of the charter school market in Texas, followed by a description of the Texas Schools Project microdata used in the study. Then we discuss the various approaches used to measure school quality, and describe the relative improvement of the charter sector and the divergence between that improvement and the stagnation of charter school quality post-2006 for the typical charter school student. The final two sections examine the contributions of specific factors to the observed improvements, and discuss policy implications and directions for future study.

I. THE TEXAS CHARTER SCHOOL PROGRAMME

Since the enabling charter school legislation was passed in 1995, the Texas charter sector has grown into one of the largest in the nation. It ranks second nationally in both the number of charters operating and the number of students served by charters in 2010–11.⁴ We first discuss the institutional structure and then describe the growth of the Texas charter sector.

Institutional structure

The Texas Education Code establishes four types of charter: home-rule school district charters, independent school district charters, university/college campus or programme charters, and open-enrolment charters. Open-enrolment charters, which are the focus of this study, constitute the majority of charter schools in the state. Also, prior to 2001, a special category of ‘at-risk charters’ could be opened if they served at least 75% at-risk students, but this category was subsequently eliminated. As shown in Figure 1, since 2001 open-enrolment charters consistently educate well over 80% of the students enrolled in the sector. Open-enrolment charters are awarded under the auspices of the Texas State Board of Education, which acts as the primary authorizer for these schools. These schools are independent public educational entities, and the state designates a unique county-district identifier for schools operating under each open-enrolment charter. District charters, by contrast, are established by and accountable to the school

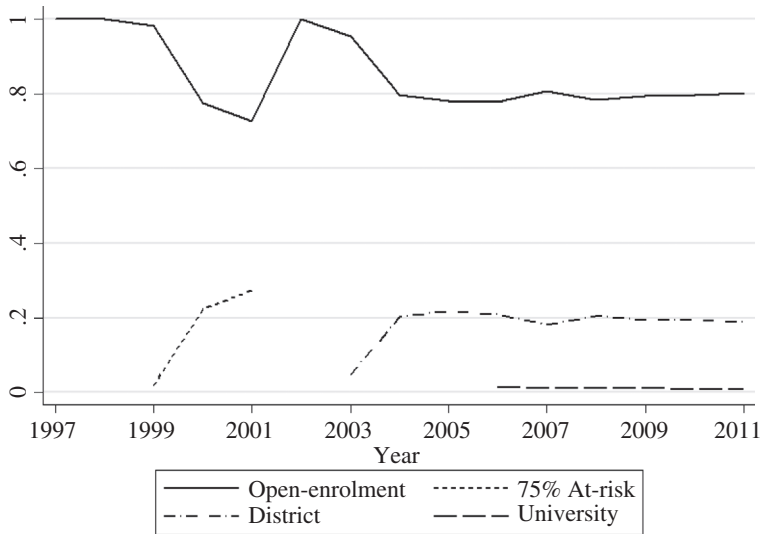


FIGURE 1. Charter sector enrolment shares by charter school type.

Notes: The figure shows the share of charter sector enrolment in each school type over time.

districts in which they reside. These charters constitute a relatively small fraction of charter schools, and educate less than 20% of students enrolled in the charter sector. University charters make up the remainder of the state's charters. Their establishment and operation is similar in character to open-enrolment charters. Thus we make no distinction between these and open-enrolment charters. No home-rule district charters have been established as the time of writing.⁵

The defining feature of open-enrolment charter schools is their receipt of public funding without many of the regulatory restrictions, chiefly in the realm of personnel, inherent to the operation of traditional public schools. They primarily fund their operations from state funds distributed according to a formula based on average daily attendance, with adjustments for student participation in special education, bilingual education, or gifted and talented programmes.⁶ In contrast to their traditional public school counterparts, they receive no local tax revenue nor any funds earmarked for buildings from the state facilities fund. In general, these charters are required to finance all school activities and infrastructure requirements from their state grants and any additional funds contributed from non-state sources.

Beyond the federal accountability requirements for teachers in core areas imposed by No Child Left Behind legislation, open-enrolment charters have almost no restrictions on hiring and firing. They may hire teachers who lack certification or bring skills and experiences that may not be rewarded in conventional public schools. In addition, open-enrolment charters are free to set salary and benefit schedules. By contrast, district charters maintain the hiring and salary rules of their home districts. This distinction leads to some differences in the characteristics of staff: open-enrolment charters tend to employ less-experienced teachers who are less likely to have a postgraduate degree. Open-enrolment charters also pay, on average, lower salaries.

Although district charters offer a degree of parental choice, they have a much weaker effect on traditional public school district enrolment and revenue relative to open-enrolment charters, as most students in district charters would alternatively have

attended a traditional public school in the same district. Thus the district charter schools put little enrolment pressure on districts. Additionally, because they typically involve existing personnel, support structures and institutions, the dynamics of start-up for district charters are quite different from those for new open-enrolment charters. In some cases, it becomes difficult to distinguish the characteristics of a district charter from those of other district schools. Therefore, because of the very different structures and incentives generated by market forces, we focus on open-enrolment charters.

Despite differences in hiring and staffing, all charters in Texas are similar in their stated goals to implement new curricular and disciplinary practices that improve the educational outcomes of their students. The path to achieving these goals differs, however, as both the public mission statements and operational choices of charters vary widely across the sector. For example, many charters combine standard skills enrichment with an emphasis on discipline; others centre the curriculum on more specialized interests such as athletics, the sciences or music and the arts. Regardless of curriculum, all charters are subject to the same accountability and testing requirements as traditional public schools. Achievement is the quality dimension central to the enabling legislation and the heart of our evaluation of performance.

Institutionally, a charter is a contract that enables outside entities to operate schools, and there is not a one-to-one match between each charter granted and a specific school (called a campus in Texas). A charter school management organization (CMO) can hold more than one charter, and each charter can include multiple campuses in the same manner that a traditional public school district can include multiple campuses. As a general rule, each charter applies to one geographic market, and a CMO entering multiple markets will have multiple charters.

From 1997 to 2000, there was no statutory limit on the number of open-enrolment charters granted to management organizations that committed to operate schools that served at least 75% 'at-risk' students, while the number of unrestricted open-enrolment charters was limited to 100. Two changes were made in 2001. In response to reports of poor performance and mismanagement at some schools, the legislature relaxed the at-risk student composition constraint.⁷ At the same time, a strict limit of 215 was imposed on the total number of charters awarded under the open-enrolment programme. This limit implicitly advantaged existing charter holders by restricting entry. Moreover, a charter holder may submit an amendment to the charter requesting to add a campus or site, and such a request is routinely approved as long as it is deemed by the authorizer to be in the best interest of the students in that market, and the charter holder is otherwise in good standing.⁸

Charter school closures typically occur following the voluntary surrender of a charter by an operator, after campus closure by an operator that retains its charter and continues to operate other schools, or by order of the state authorizer. Operators may close a school in response to limited demand, financial considerations, or simply a desire to leave the market. Authorizer closures can occur because of persistent poor performance, failure to maintain financial soundness, or financial or operational malfeasance.⁹ In these cases, the authorizer performs an investigation, and, if the violation is deemed of sufficient severity, then it will issue a ruling that the charter school operator should have their charter revoked.

Open-enrolment charter school growth

Figure 2 illustrates the growth in open-enrolment CMOs, charter districts and charter campuses between 1996 and 2011. Prior to 2001, entry of charter school operators and

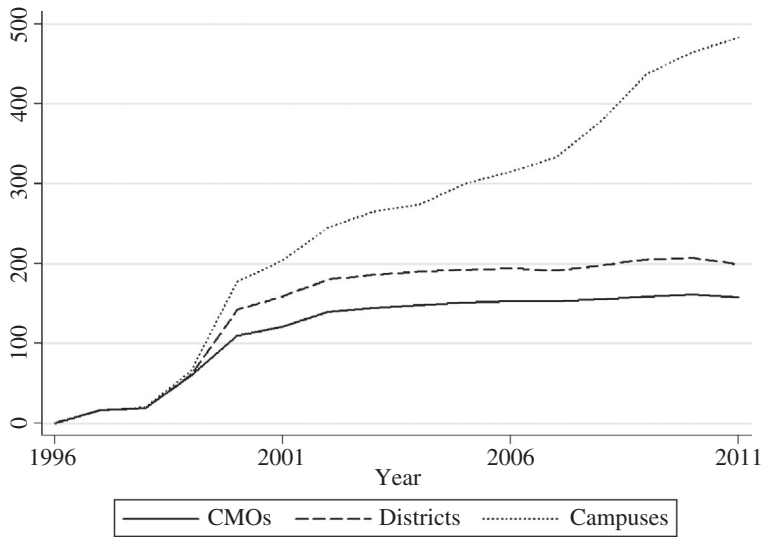


FIGURE 2. The growth in open-enrolment charter schools, 1996–2011.

Notes: The figure shows the number of charter school management organizations (CMOs), charter districts, and charter campuses operating in Texas over time.

the establishment of new districts constituted the bulk of expansion in the charter sector, as the numbers of both charter holders and charter districts increased. After 2001, however, the numbers of CMOs and charter districts remained roughly stable (around 150 holders and 200 charter districts), while the number of schools roughly doubled. Charter school enrolment as a share of total public school enrolment increased along with the increase in the numbers of districts and campuses, rising to roughly 1.5% in 2001 and 4% in 2011.

Figure 3 shows the stock and flow of charters by type. It includes the number of charter districts by active status relative to the state limit, as well as the number of annual charter authorizations and discontinuations. The number of charters increased up to 2001 partly due to the elimination of the separate ‘at-risk’ charter category and the more than doubling of the cap on unrestricted open-enrolment charters. The annual increase in the number of new charter districts, however, declined steadily between 1999 and 2002 as the number approached the cap, and it remained quite low thereafter. Similarly, the number of discontinued charters remained small throughout this period.

Figure 4 illustrates a typical example of CMO expansion using the entry and growth of *America Can!* up to 2011 as an example. *America Can!*, a 501(c)(3) non-profit organization, successfully applied for a charter in Dallas and operated one of the first charter schools in Texas in 1997. This CMO subsequently expanded along two dimensions. First, it received an additional four open-enrolment charters (covering Houston, San Antonio, Fort Worth and Austin) between 1999 and 2005 for a total of five charter districts; and second, it increased the number of campuses operating in three of these districts. This pattern highlights a key aspect of the regulatory structure of charter schools in Texas: the approval process that charter districts in good standing face when seeking to expand the number of schools is far less involved than the approval process for a new charter. This observation also suggests that the cost of procuring approval for an additional school is likely to be modest relative to other costs associated with adding a school.

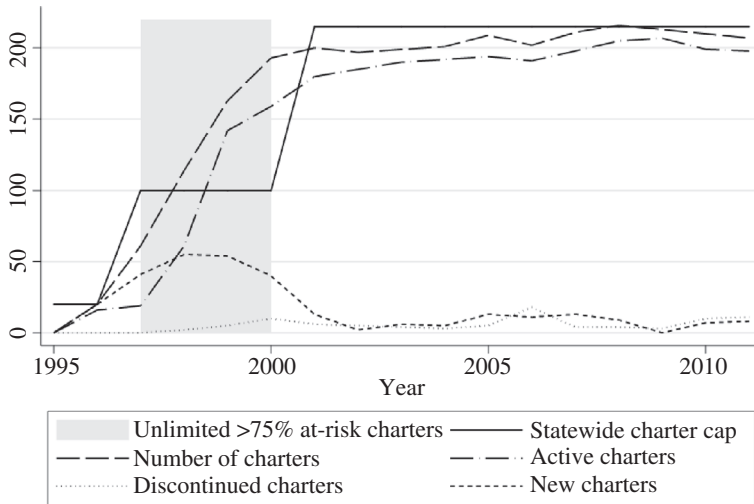


FIGURE 3. Stock and flows of state charters by type, 1995–2011.

Notes: Data drawn from Texas Schools Project data on schools.

II. THE UTD TEXAS SCHOOLS MICRODATA PANEL

The cornerstone of this research is the microdata constructed by the Texas Schools Project at the University of Texas at Dallas (UTD). These data include test scores, demographic characteristics and information on school attendance and academic programmes for a stacked panel of students and schools.¹⁰ Our analysis focuses on the over 366 separate charter school campuses and their enrollees operating over the period spanning 2001 to 2011. School information includes charter school type, state accountability rating, and information on all staff. Student information includes demographics, mathematics and reading test results, school attended, grade, and academic programme. Students who switch schools, including between traditional public and charter schools, can be followed as long as they remain within the Texas public school system.¹¹

Mathematics and reading assessments come from statewide criterion-referenced achievement tests administered during our period of study. From 1993 to 2003, the Texas Assessment of Academic Skills (TAAS) was administered each spring to students enrolled in grades 3–8. In 2003, Texas introduced the Texas Assessment of Knowledge and Skills (TAKS).¹² TAKS expanded the number of subjects for which students were required to demonstrate proficiency, and elevated the difficulty of the tests. Because the tests are not vertically aligned, they cannot be used to measure absolute changes over time in charter school quality; rather, they provide information on performance relative to other students and schools in the same grade and year. Because the test structure, number of questions and average percent correct vary across time and grades, we standardize all test scores to have a mean of zero and a variance equal to one for each grade and year. Backes *et al.* (2018) find that measures of teacher value-added tend to be stable across and within test regimes. Nonetheless, to address potential concerns associated with imposing a new testing regime, we examine the sensitivity of the results to changes from TAAS to TAKS.

Any school without students in the TAAS/TAKS data is excluded from the sample; therefore our number of charters will differ from public records of the number of

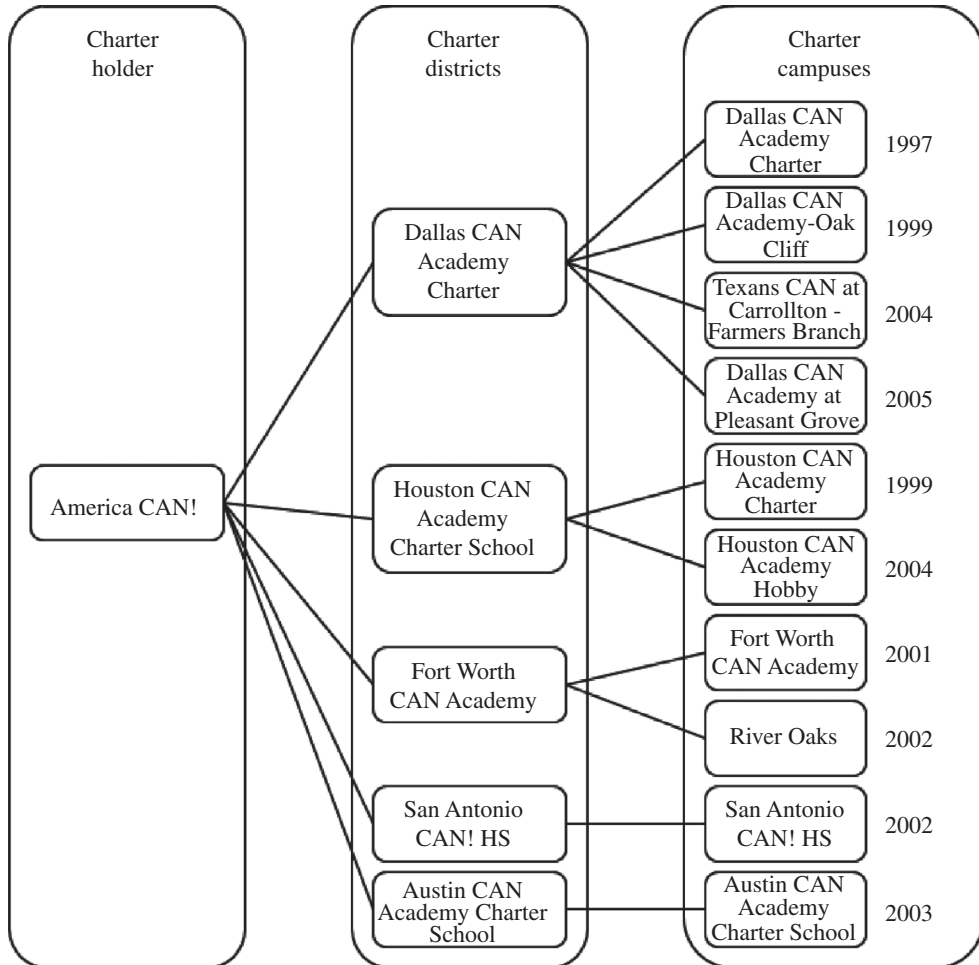


FIGURE 4. An example of the charter sector organizational structure: the expansion of the *America Can!* CMO from 1997 to 2011.

authorized charter schools.¹³ Also omitted are those charter schools exclusively serving children with special needs, residents in treatment programmes, and students with diagnosed behavioural problems.

For the subsequent analysis of charter sector improvement, we construct a database that incorporates the operational focus of each charter school. Using information gathered through interviews and records investigations, we classified each CMO on the basis of whether or not it adheres to a No Excuses philosophy as defined below in Section V and in the Appendix.

III. MEASURING CHARTER SCHOOL QUALITY

The primary concern in measuring charter school performance is that unobserved differences between charter school and traditional public school attendees contaminate comparisons of achievement in the two sectors. This is particularly salient in this

analysis, as evidence below illustrates the increasingly positive selection of charter school entrants in terms of prior achievement. Although random assignment methods that make use of lottery data can be used to estimate the effectiveness of oversubscribed charter schools, such approaches cannot be used to study an entire market in which the majority of schools are not oversubscribed. Nonetheless, comparisons of lottery-based data and selection on observables estimates based on the same data provide information on the implications of alternative approaches when lottery data are not available. Importantly, the most commonly used value-added and matching models based on prior traditional public school attended differ not only in their treatment of unobserved heterogeneity but also in the composition of the comparison set of traditional public schools.

We begin with a school-level value-added model (which becomes the base specification in our subsequent statewide estimation). In the context of this model, we highlight potential problems introduced by purposeful sorting of students into schools. From there we consider matching estimators that also estimate value-added models but employ different estimation samples, here focusing on the approach proposed and implemented by Angrist *et al.* (2013). Throughout, we highlight additional considerations related to our focus on the estimation of changes over time in charter school effectiveness.

Alternative empirical models

Our baseline specification is a school-level value-added model that we estimate separately for each year and subject in order to describe the full distributions of school quality across both traditional and charter schools. Achievement A for student i in grade g and school s is modelled as a function of prior achievement, prior behavioural infractions (D), contemporaneous student and family factors (X), a school fixed effect that measures school quality (δ_s), and a random error:

$$(1) \quad A_{igs} = f(A_{i,g-1}) + 1[D_{i,g-1}] + X_{igs}\beta + \delta_s + \varepsilon_{igs}.$$

Following the literature, we control for prior achievement with cubic functions in both mathematics and reading scores. We also include an indicator for whether the student committed any disciplinary infraction in the prior year.¹⁴ The vector X includes a broad set of demographic characteristics: indicators for race, ethnicity, gender, low-income household, prior grade retention, and whether the student was enrolled in a special education programme. We also include indicators for whether the student switched schools prior to taking their exams within the school year, and control for the grade structure of the school. Note that for expositional ease we suppress grade-year fixed effects that capture grade-specific changes over time in the test instruments and state policies.

In contrast to studies that control for achievement prior to charter school entry and estimate the charter school effect over the entire period in the charter, we focus on annual value-added to achievement to estimate charter school effectiveness for each year and account for the extensive mobility into and out of the sector. This assumes that prior achievement is a sufficient statistic to account for the effects of past family and school inputs, including attendance at a charter school in the previous year. Use of a lagged dependent variable may introduce bias to the other estimates, including the school fixed effects. The direction and magnitude of any bias to the fixed effects depends in part on the

character of selection into charter schools and the magnitude of school effects relative to family inputs and other factors. Our analysis suggests that selection into charter schools is becoming more positive over time, and this would be expected to bias downwards estimates of charter school improvement. Moreover, school effects during this period explain only a small portion of the variation in prior achievement. Therefore the complications introduced by the focus on annual value-added are likely to be quite modest.

The validity of the school fixed effects as measures of productivity depends on the assumption that the prior test scores, disciplinary infraction measures, mobility controls and other included variables account for confounding factors. Although a vigorous debate continues about the estimation and use of teacher value-added measures, much less attention has been paid to such estimation at the school level. Two concerns that dominate the discourse around teacher value-added are less important here. First, researchers often disagree about the extent to which systematic student sorting, both within and between schools, contaminates estimates of teacher value-added. Rothstein (2010) provides evidence of bias introduced by endogenous sorting into classrooms, but Chetty *et al.* (2014) find that including one-year lagged achievement in cubic form along with common demographic characteristics effectively eliminates bias.¹⁵ Our focus on average school quality rather than the effectiveness of individual teachers, however, reduces the relevance of issues related to classroom placement.¹⁶ Second, concerns about the variance of estimation error and the instability of teacher effects, particularly in proposed uses for personnel decisions, have been extensively discussed. These problems are, however, largely related to small samples for classroom teachers (McCaffrey *et al.* 2009) and are less important at the school level.

Nevertheless, the possibility remains that the included variables fail to account fully for sorting among schools. Research on charter schools has adopted a variety of approaches to account for unobserved heterogeneity, and the merits of each have now been examined extensively. We focus primarily on school value-added measures within the context of alternative approaches.

In terms of internal validity, admission lotteries constitute the gold standard, as they effectively randomize assignment to charters and, in the absence of non-random attrition, produce consistent estimates of charter school effects. However, only oversubscribed schools conduct admission lotteries, and an analysis of sector dynamics must cover all charter schools. Although comparisons between lottery and observational estimates of charter school quality employing value-added approaches do not exist for Texas, Angrist *et al.* (2017)—building on work by Abdulkadiroğlu *et al.* (2011), Dobbie and Fryer (2013) and Deming (2014)—present evidence on the bias of conventional value-added estimators relative to lottery-based estimators of charter value-added. In general, they conclude that though conventional value-added estimates are biased, the bias is small and the estimates tend to be both qualitatively and quantitatively similar to the experimental results. Moreover, they argue on the basis of these results that estimates from conventional value-added models contain information about the effectiveness of teachers and schools, and are useful for policy-related decision-making.

Matching of charter school students with observationally equivalent students in the traditional public schools from which new charter entrants originate has been used in several recent studies; for example, see CREDO (2013) and Angrist *et al.* (2013), along with studies investigating the correspondence of lottery and observational estimates. Although these matching approaches do not address selection on unobservables, they do account for systematic differences in observed characteristics and the composition of

traditional public schools previously attended by charter school students.¹⁷ In an evaluation of alternative approaches, Fortson *et al.* (2012) find that such matching methods produce estimates that are not significantly different from lottery-based estimates over the same sample of schools; similar to the aforementioned studies, this work finds that estimates produced by regression adjustments without matching of students tend to be close in magnitude though statistically different.

Our alternative specification is similar in spirit to the model presented in Angrist *et al.* (2013). Specifically, our model compares charter school students who transition from a traditional public school with students from the same traditional public school, grade and demographic group who remain in the traditional public school sector for the subsequent grade.¹⁸ More specifically, we construct comparison group p for each charter enrollee using a full set of race/ethnicity-gender-traditional public school dummy variables (θ) that indicate the race/ethnicity-gender-traditional public school attended prior to entry into a charter school by the student or a classmate (in the case of students remaining in the traditional public sector):

$$(2) \quad A_{igps} = f(A_{i,g-1}) + 1[D_{i,g-1}] + X_{igs}\beta + \theta_p + \eta_s + \varepsilon_{igs},$$

where $\theta_p = 1$ if a student falls into that race/ethnicity, gender, traditional public school cell. In this specification the value-added of each charter school, η_s , equals the average achievement difference between charter entrants and controls in the same comparison group, conditional on prior achievement and other variables. As was the case with the statewide value-added estimator, we estimate the matching value-added model separately by year and subject, controlling for prior achievement with cubic functions in both mathematics and reading as well as grade-year effects. The vector X includes the same set of controls as the statewide estimator other than the characteristics used for matching.

Although prior discussions have emphasized the degree to which the different estimators account for unobserved heterogeneity, sample differences may also alter the distributions of estimates for both charter and traditional public schools. This complicates the interpretation of any observed differences among lottery-based, matching and simple regression-adjusted value-added models. A measure of the mean sector difference based on value-added estimates would weight each school by its sector enrolment share. By comparison, the corresponding measure based on a matching model of the type used in Angrist *et al.* (2013) would weight each school by its sector sample share, where sample inclusion requires finding an appropriate match by race/ethnicity-gender-traditional public school attended. Specifically, including any students from a grade and demographic cell for a school in a given year such as 2001 requires at least one student in that cell to have previously transitioned from the traditional sector and remained in the charter sector in 2001.¹⁹

Differences between the samples for the two estimation approaches highlight both the separate appeal of the estimators and the pronounced difference in the traditional public school enrolment distributions used to construct the comparison. In the case of the matching model, there is common support across sectors in terms of demographic characteristics and prior traditional public school attended, implying that the traditional public school comparison group invariably reflects a geographic distribution similar to that of the charter schools. The statewide estimator includes all traditional public schools in Texas, even if some were not feeder schools for the charter sector, thereby reflecting the full range of educational opportunities. This contrast may contribute to the finding in

Fortson *et al.* (2012) of a greater similarity between lottery-based and matching estimators than between lottery-based and value-added estimators. Of course, the greater similarity may also result from the matching model sample restrictions mitigating selection bias.

In our context of a rapidly growing charter sector, matching model estimates of changes over time in the charter-traditional public school quality differential will partially reflect any changes over time in the quality of the traditional public schools previously attended by charter sector entrants.²⁰ Consider both the response to a change in the quality of a charter school and the expansion of the charter sector. If a charter school improves, then it is likely to appeal to students from higher-quality traditional public schools. In addition, because a CMO is likely to consider the local demand for charter schools in deciding where to open a school, a decline in the quality of traditional public schools in a community may elevate the probability that a charter school opens. Each of these processes could lead estimates of changes in mean sector differences based on matching methods to diverge from those produced by a statewide value-added model because changes in the pattern of charter school entry would have a negligible effect on traditional public school enrolment shares in the latter.²¹

Relatedly, any competitive effects of charter schools on the quality of instruction in the traditional sector are likely to be strongest in schools directly affected by charter school competition. Therefore matching models might be more sensitive to general equilibrium effects that dampen estimates of charter sector improvement. In a preliminary analysis (not reported), we found a strong positive relationship between charter school quality and the quality of the origin schools in the traditional sector after controlling for school fixed effects. While this association does not provide causal evidence of a competitive response, it is consistent with such an effect.

All in all, differences between the estimators in the distributions of students among both charter and traditional public schools, and the treatment of unobserved heterogeneity, lead us to provide estimates for both statewide and matched samples. These will illuminate the sensitivity of the findings to the empirical specification and comparison group.

IV. EVOLUTION OF THE CHARTER SCHOOL QUALITY DISTRIBUTION

We begin with a description of changes over time in charter school mathematics and reading value-added between 2001 and 2011 relative to traditional public schools. We then examine the contributions of school improvement, school closures and the entry of new schools to these changes. We provide parallel estimates for a statewide comparison group used in the value-added model and for the more localized comparison group used in the matching estimator.

Trends in charter school effectiveness

In what follows, we first illustrate changes over time in relative charter school effectiveness based on unweighted school value-added estimates, and then show figures based on enrolment-weighted versions of these estimates. The distribution of school value-added unweighted by enrolment highlights the evolution of the school quality distribution, while comparisons with trends in enrolment-weighted estimates illustrate how sorting across schools affects the evolution of school quality experienced by charter-school students relative to that experienced by students in traditional public schools.

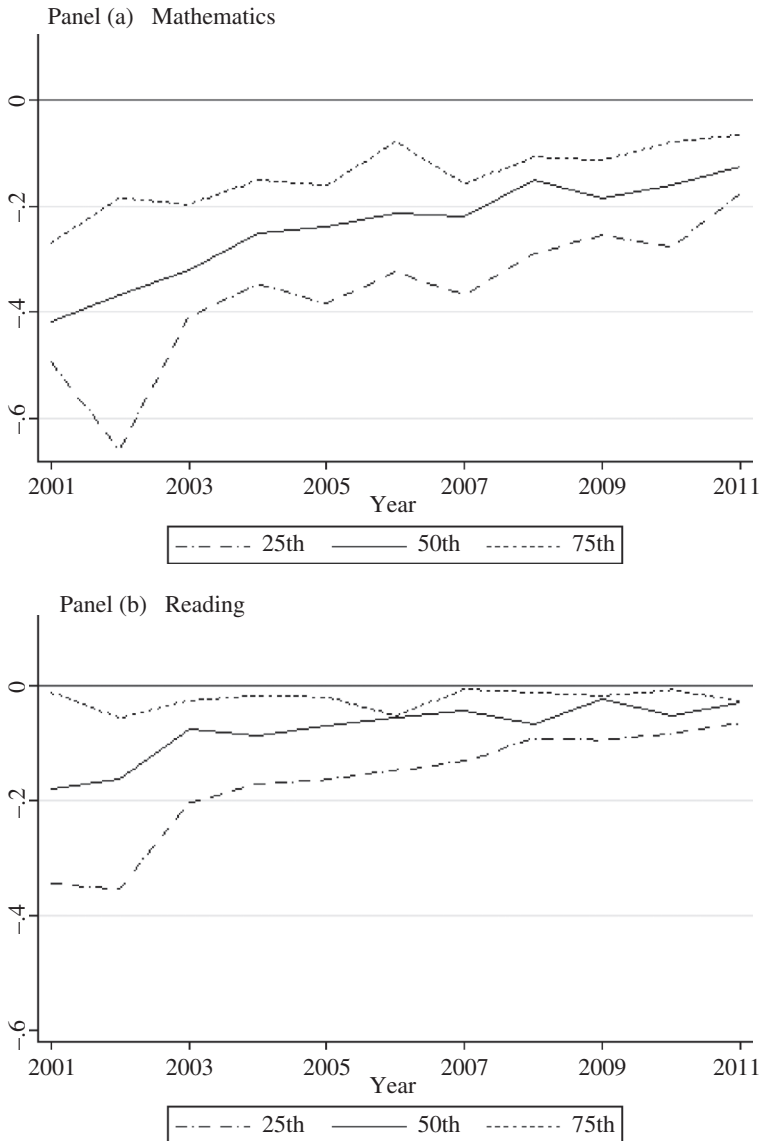


FIGURE 5. Charter school quality quartiles over time relative to traditional public schools (statewide comparisons).

Notes: The graphs show the differences between the 25th, 50th and 75th percentiles of the charter and traditional public school quality distributions based on statewide value-added models.

Figure 5 illustrates changes over time in the 25th, 50th and 75th percentiles of charter school value-added in mathematics and reading relative to the corresponding percentiles of the traditional public school mathematics and reading statewide distributions. Over the decade, relative improvements in charter school mathematics value-added (panel A) occurred throughout the distribution following a small decline between 2001 and 2003 when the state test was changed. The gaps at the 25th and 50th percentiles fell from roughly 0.4 to less than 0.2 standard deviations, while the difference at the 75th percentile declined from roughly 0.2 to 0.05 standard deviations.

Panel B of Figure 5 illustrates smaller initial deficits and smaller charter sector improvement in reading value-added, though gains are similarly more pronounced at the lower percentiles. Across the full period, the gain at the 25th percentile was over 0.2 standard deviations, the gain at the 50th percentile was 0.15 standard deviations, and the gain at the 75th percentile was roughly 0.05 standard deviations. By comparison to mathematics, the improvements in reading value-added come much closer to eliminating sector gaps throughout the distribution by 2011.

The trends in the matching estimates presented in panels A and B of Figure 6 show similar overall improvement of charter relative to traditional public schools, despite the differences in the underlying structures of the models. In contrast to the statewide comparison trends composed of differences at comparable percentiles in the charter and traditional public school value-added distributions, the matching trends reflect the ordering of charter schools on the basis of performance relative to their unique and changing sets of traditional public school controls.

Entry, exit and improvement

It is informative to disaggregate the trends in relative charter school effectiveness between 2001 and 2011 into performance changes associated with entry, market (i.e. voluntary) closures, authorizer closures and school improvement. Tables 1 and 2 illustrate the contributions of these components to the changes in charter school performance between 2001 and 2011 using the statewide and matching estimates, respectively.

The average improvements of charter school value-added based on the statewide comparison model are 0.25 and 0.22 standard deviations in mathematics and reading, respectively. Table 1 shows that these performance gains are attributable to a combination of: (1) improvements in charter schools that persist throughout the period (panel A); (2) the disproportionate closure of lower value-added schools (panels B and C); and (3) an average value-added of new schools that far exceeds that of the schools that closed (panel D). Value-added improved by 0.14 standard deviations in mathematics and 0.12 standard deviations in reading for schools that remained open throughout the entire period. The average value-added of both voluntary and authorizer closures lies between -0.5 and -0.6 standard deviations for both mathematics and reading, far below the sector averages. Finally, the significantly higher average value-added of schools that entered post-2001 compared to those operating at the beginning of the period illuminates the importance of compositional changes to charter school gains.²² Notice also that the contribution of entrants is amplified by their large market share.²³

The somewhat larger average changes estimated by the matching estimators are 0.28 and 0.23 standard deviations in mathematics and reading, respectively. Table 2 disaggregates these changes into the contributions for the same categories of school entry, closures and improvement. The patterns in the table are qualitatively similar to those for the statewide comparison, but there are some quantitative differences. Specifically, the matching model estimates show much larger improvements for schools open throughout the period, and state-authorizer closures are even more negatively selected, particularly in reading. This suggests that the quality of the alternative traditional public schools (which is localized with the matching estimator) is associated with charter school closure decisions.

All in all, the similarity between the estimators in the overall patterns of relative quality changes for charter schools, including the importance of compositional changes, strengthens the case that charter schools improved relative to traditional public schools between 2001 and 2011. Even accounting for any changes over time in the observable

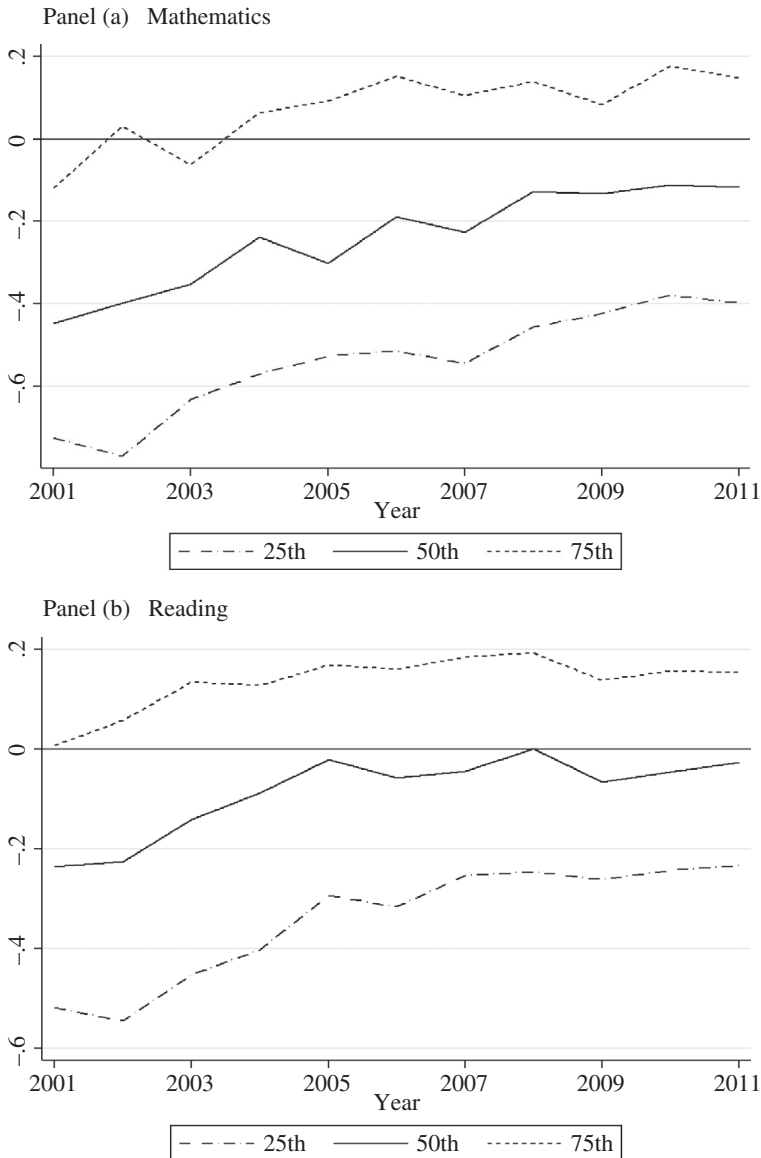


FIGURE 6. Charter school quality quartiles over time relative to traditional public schools (matching procedure).

Notes: The graphs show estimates at the 25th, 50th and 75th percentiles of charter school quality distributions relative to traditional public schools based on matching models.

characteristics of, and prior schools attended by, charter school entrants using the matching model does not reduce the estimates of relative improvement over the decade.

Enrolment and school effectiveness

Enrolment decisions determine the extent to which the rightward shift in the school quality distribution translates to improvements in school effectiveness for students. An

TABLE 1
 AVERAGE CHARTER SCHOOL MATHEMATICS AND READING VALUE-ADDED AND ENROLMENT SHARES FOR 2001 AND 2011, BY STATUS OF SCHOOL OPERATIONS (STATEWIDE ESTIMATES)

	Mathematics		Reading	
	2001	2011	2001	2011
<i>A. Schools in operation in 2001 and in 2011</i>				
Average value-added	-0.258	-0.120	-0.194	-0.075
Share of charter enrolment	0.78	0.19	0.78	0.19
Average campus age	2.47	12.44	2.47	12.44
Number of schools	66		66	
<i>B. Market closures</i>				
Average value-added	-0.598		-0.551	
Share of charter enrolment	0.17		0.17	
Average campus age	2.11		2.11	
Number of schools	27		27	
<i>C. Authorizer closures</i>				
Average value-added	-0.519		-0.597	
Share of charter enrolment	0.06		0.06	
Average campus age	2.23		2.23	
Number of schools	13		13	
<i>D. Schools in operation in 2011 but not in 2001</i>				
Average value-added		-0.146		-0.083
Share of charter enrolment		0.80		0.80
Average campus age		4.81		4.81
Number of schools	253		253	

Notes

Average value-added for charter schools is net of traditional public school average value-added in each year. Empty cells in panels B, C and D correspond to years when these school categories are no longer in operation or have yet to begin operation. Estimates are constructed using the statewide comparison group.

increasing concentration of students in more effective charter schools would amplify the improvements in the school quality distribution, while a weakening of the association between enrolment and charter school effectiveness would attenuate the gains to students.

Figure 7 illustrates changes over time in the 25th, 50th and 75th percentiles of the distributions of school quality for charter school students relative to those in traditional public schools in mathematics and reading, using both the statewide comparisons and matching estimates. A comparison of each graph to the corresponding distributions of school quality shown in Figures 5 and 6 reveals two patterns that span subject and method. First, students are concentrated in higher value-added charter schools throughout the period, such that value-added in the distribution of school quality for students exceeds that in the distribution of schools at the 25th, 50th and 75th percentiles for both subjects and methods in all years. Second, in contrast to steady charter school gains in mathematics value-added throughout the distribution and in reading value-added at the 25th percentile illustrated in Figures 5 and 6, the enrolment-weighted distributions shown in Figure 6 flatten out around the middle of the ten-year period. This indicates a weakening of the association between enrolment and school quality, because

TABLE 2
 AVERAGE CHARTER SCHOOL MATHEMATICS AND READING VALUE-ADDED AND ENROLMENT SHARES FOR 2001 AND 2011, BY STATUS OF SCHOOL OPERATIONS (MATCHING ESTIMATES)

	Mathematics		Reading	
	2001	2011	2001	2011
<i>A. Schools in operation in 2001 and in 2011</i>				
Average value-added	-0.326	-0.065	-0.294	-0.072
Share of charter enrolment	0.78	0.19	0.78	0.19
Average campus age	2.47	12.44	2.47	12.44
Number of schools	66		66	
<i>B. Market closures</i>				
Average value-added	-0.566		-0.506	
Share of charter enrolment	0.17		0.17	
Average campus age	2.11		2.11	
Number of schools	27		27	
<i>C. Authorizer closures</i>				
Average value-added	-0.736		-0.898	
Share of charter enrolment	0.06		0.06	
Average campus age	2.23		2.23	
Number of schools	13		13	
<i>D. Schools in operation in 2011 but not in 2001</i>				
Average value-added		-0.166		-0.062
Share of charter enrolment		0.81		0.81
Average campus age		4.81		4.81
Number of schools	253		253	

Notes

Average value-added for charter schools in each year. Empty cells in panels B, C and D correspond to years when these school categories are no longer in operation or have yet to begin operation. Estimates are constructed using the matching comparison group.

the improvement in the quality distribution of charter schools does not translate into corresponding improvements in the distribution of school quality for students.

This weakening might suggest that market pressures for higher-value-added schooling lose strength as the sector matures. A simpler explanation, however, comes directly from the expansion of the sector. The entry of many new schools each year without any performance record would naturally dampen the association between enrolment and quality. As Figure 8 shows, the entry of charter schools and the share of students in new charter schools accelerated after 2004 and jumped precipitously in 2007.

Consider just schools for which there is some history of performance. Figure 9 presents trends in unweighted and enrolment-weighted median reading and mathematics charter school value-added for campuses not in the initial year of operations based on both statewide comparisons and the matching model. In all four graphs the trends in median school quality and median school quality for students move much more closely together than those shown in Figures 5, 6 and 7. In fact, there is virtually no difference between the rightward shifts in the unweighted and enrolment-weighted distributions of mathematics and reading value-added between 2001 and 2011, regardless of the estimation method. These are not consistent with a weakening of the association between enrolment and quality.

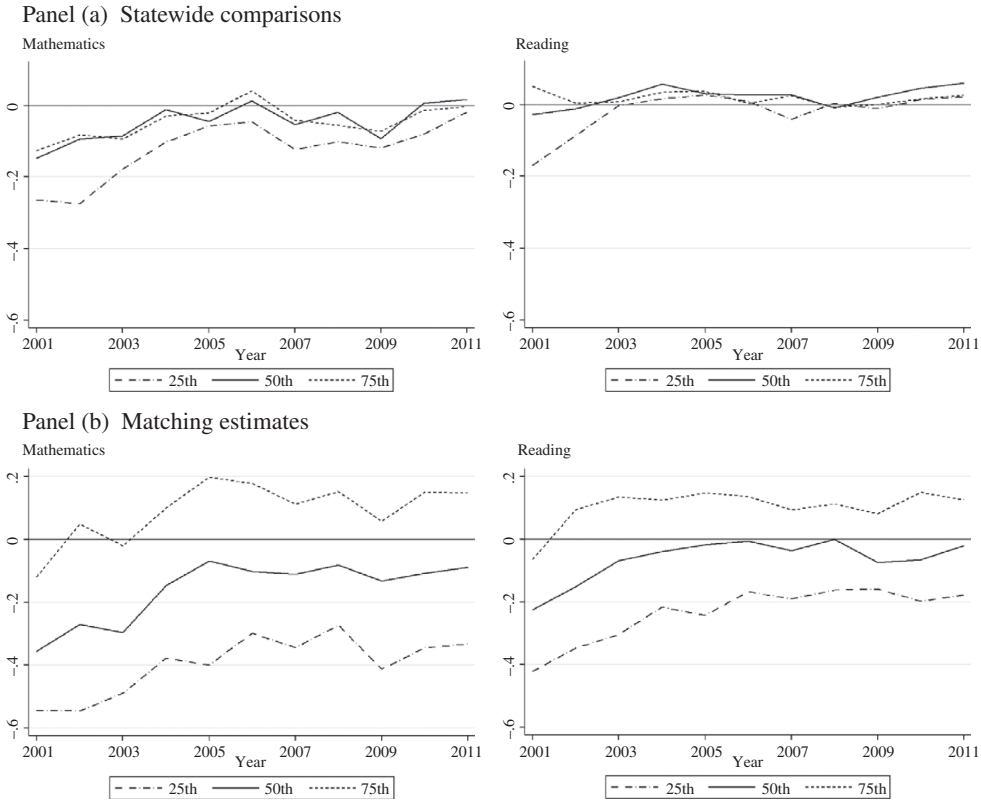


FIGURE 7. Enrolment-weighted quartiles of value-added relative to tradition public schools.
 Notes: The graphs show estimates at the 25th, 50th and 75th percentiles of charter school quality distributions relative to traditional public schools based on statewide comparison and matching models.

Placing relative improvements in context

Importantly, interpretation of these findings in terms of the absolute level of charter school quality depends in part on changes in the traditional public school sector. If, for example, the quality of traditional public schools in Texas fell during this period due to the expansion of the charter sector or other factors, then the catch-up of charter schools may not indicate much, if any, quality improvement. Alternatively, if traditional public schools improved—either in response to competition from the charter sector or for other reasons—then the observed increase in charter school quality would actually understate the increase in charter school effectiveness. Imberman (2011) highlights the difficulty of identifying the causal effect of competition on traditional schools. Therefore we simply describe changes over time in state average achievement to provide a context for the relative improvement of the charter sector.

During the sample period, the general increase in scores on the National Assessment of Educational Progress (NAEP) suggests a positive change over time in the quality of public education in Texas.²⁴ The average NAEP score improved from 2000 to 2011 in fourth- and eighth-grade mathematics. The average NAEP score improved in fourth-grade reading and remained constant from 1998 to 2011. Given the increase over time in the minority enrolment share and the lower average scores of blacks and Hispanics

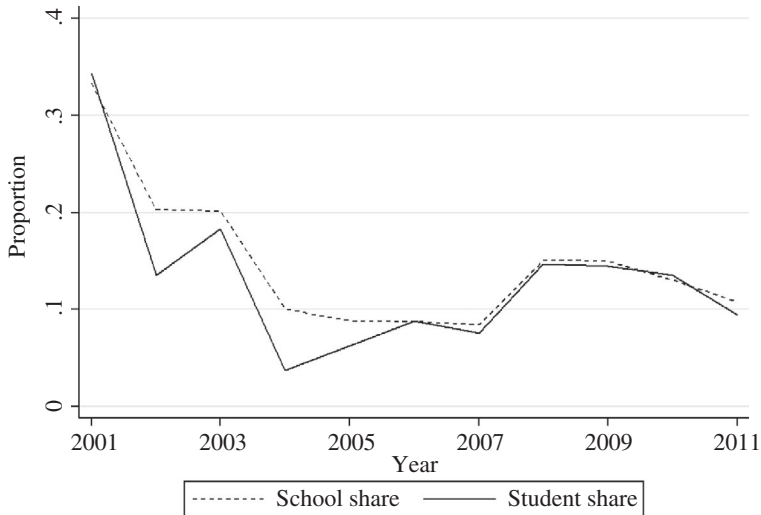


FIGURE 8. Fraction of schools in the first year of operation and fraction of students attending schools in the first year of operation.

Notes: Share data calculated using Texas Schools Project data on charter schools and students.

compared to whites, the improvements in the overall average NAEP scores may well underestimate the gains in school quality. Looking at subgroups, whites, blacks and Hispanics each improved over this period on all NAEP tests, including eighth-grade reading.²⁵ Thus the relative improvement of charter schools is not driven by a decline in the average quality of traditional public schools; rather, our estimates likely understate the gains in absolute performance.

V. EXPLORATORY ANALYSIS OF THE SOURCES OF IMPROVEMENT

The belief that students are inputs into education production in addition to being consumers of its output guides the model of schooling demand in the seminal work by Epple and Romano (1998). It has been reinforced by extensive work on peer effects in schools.²⁶ Informal conversations with CMO executives indicate that many share this belief. These executives, however, tend to emphasize student behaviour rather than achievement. The No Excuses philosophy encapsulates this theory, often featuring a number of rules or policies, including strict discipline, contracts that require parental commitment, and uniforms aimed at creating a positive environment for learning (see Thernstrom and Thernstrom 2003; Mathews 2009). These rules may contribute to a positive environment both through their direct effects on behaviour and through their influence on enrolment and re-enrolment decisions.

Existing research on the determinants of charter school effectiveness focuses on school culture and operations, and there is less focus on student composition. Although the absence of experimental variation precludes strong causal inferences, evidence reported by Furgeson *et al.* (2012), Angrist *et al.* (2013), and Dobbie and Fryer (2013) highlights the particularly strong performance of charter schools that set high expectations, require uniforms, or more broadly adopt a No Excuses philosophy. Questions have emerged about the contribution of student composition and whether unobserved heterogeneity contributes to the advantages observed for schools that adhere

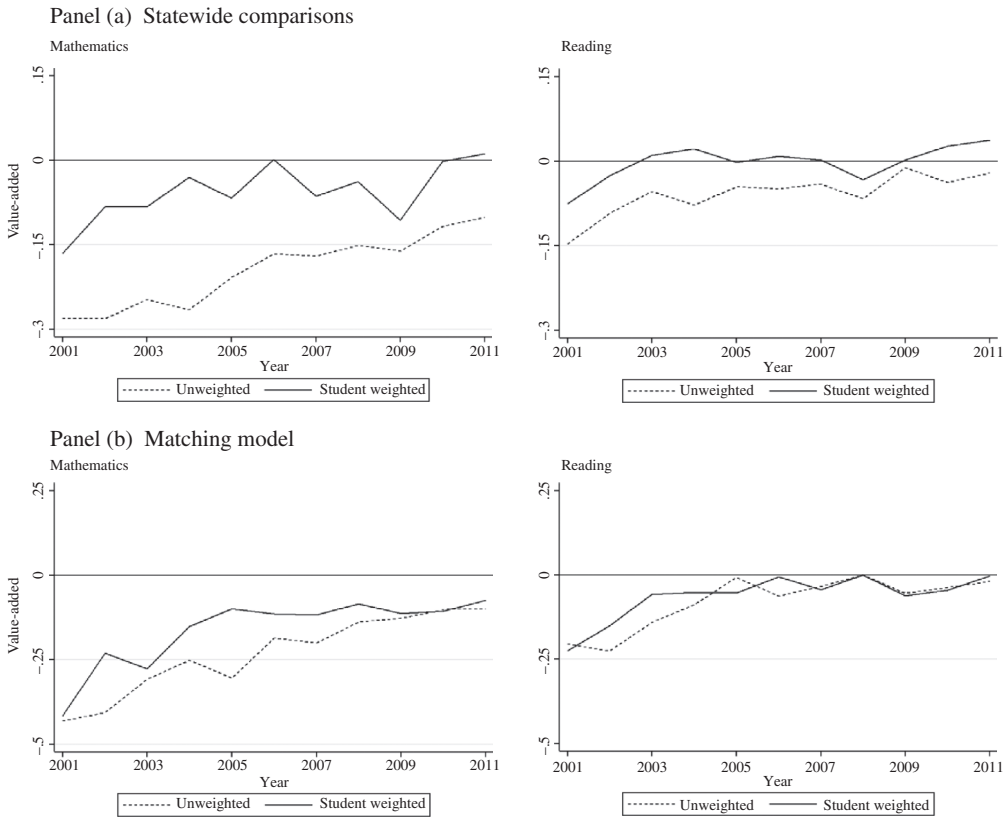


FIGURE 9. Unweighted and enrolment-weighted median charter school value-added relative to traditional public schools for charter schools not in the first year of operation.

Notes: The graphs show estimates at the median of charter school quality distributions relative to traditional public schools based on statewide comparison and matching models.

to a No Excuses philosophy.²⁷ However, in the traditional public school context, Fryer (2014) conducts a field experiment in several large urban districts in which a set of charter school best practices identified in Dobbie and Fryer (2013)—including a culture of high expectations—was implemented in the local public schools. The findings suggest that implementing these practices led to increased gains in mathematics but not in reading.

In this section, we examine the association between various dimensions of student composition and school quality and the sensitivity of estimates of the benefits of adherence to a No Excuses philosophy to the inclusion of the student composition variables. We begin by describing trends in the share of schools that adhere to a No Excuses philosophy, student mobility, and selection on prior achievement and behaviour. Next, we report estimates of the relationship between charter school value-added and adherence to a No Excuses philosophy for a series of models that progressively add controls for mobility and selection.

Importantly, the designation of a CMO as adhering to a No Excuses philosophy is not straightforward, as many that appear to operate with rules and practices that correspond to the No Excuses philosophy do not designate themselves in this way. We

classified all charter schools according to the elements of a No Excuses approach as opposed to their self-identification. The Appendix describes the extensive information and decision rules that we use to determine whether a CMO should be classified as following a No Excuses philosophy.

Variable trends over time

Figures 10, 11 and 12 illustrate trends over time in the share of charter school students attending a school that adheres to a No Excuses philosophy, in student turnover and in student selection, respectively. Figure 10 shows that, by our measures, the share of students attending Texas charter schools classified as adhering to a No Excuses philosophy increases from roughly 36% to 52% between 2001 and 2011. The next two figures reveal trends over time that are also consistent with selection and mobility accounting for a portion of charter school gains, and potentially, some of the association between value-added and a No Excuses philosophy. Figure 11 traces the proportion of charter and traditional public school students that are new to their school. For this we exclude students for whom the previous grade was not offered in the previous year, meaning that the sample excludes students in brand new schools or the lowest grade offered in a school. In 2001, roughly half of the charter school students in this restricted sample were new to the school, as compared with 18% of students in traditional public schools. The sector differential declined steadily throughout the period, falling below 10 percentage points in 2011.

To illustrate the changes in composition of the students in charter schools, Figure 12 plots the mean differences in mathematics and reading achievement and the probability of committing a disciplinary infraction between traditional public school students who transition to a charter school in the subsequent year and their schoolmates who remain in the traditional sector. Importantly, all comparisons of achievement and behaviour are based on the year prior to charter school entry and thus rule out any influences of the charter school. Moreover, disciplinary infraction

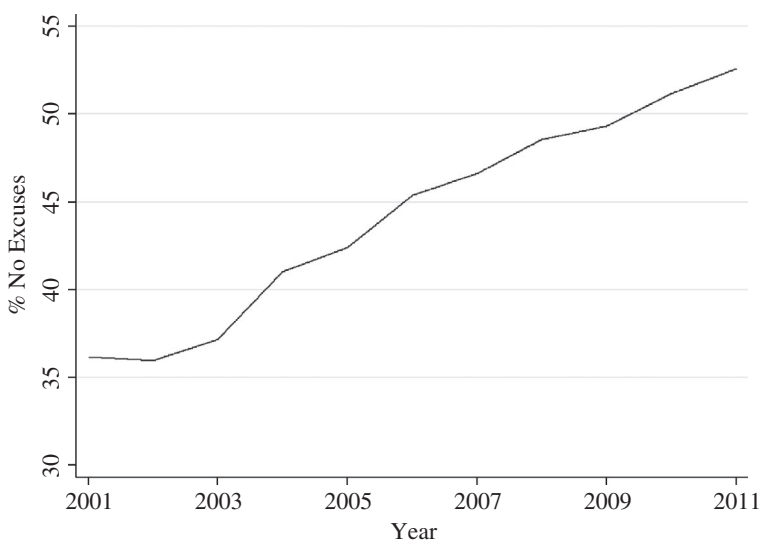


FIGURE 10. Trends over time in the share of charter schools that adhere to a No Excuses philosophy.

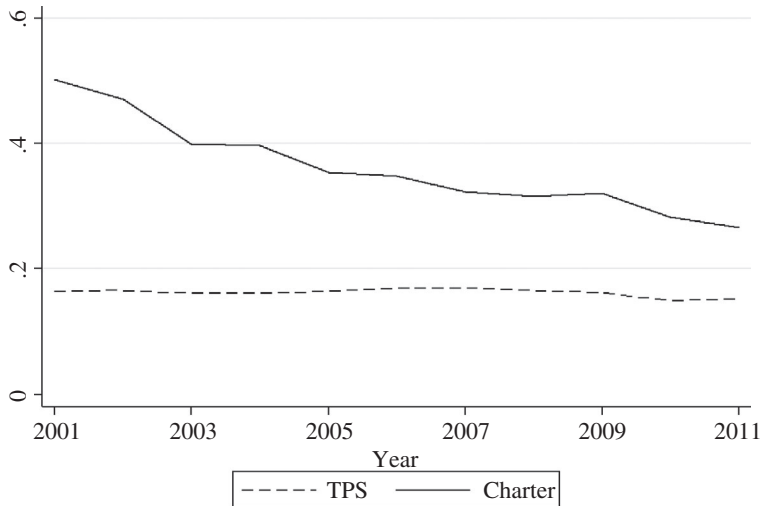


FIGURE 11. Proportion of students that are new to the school in charter and traditional public sectors, 2001–11.

Notes: Excludes schools in first year of operation and the lowest grade offered in each school.

comparisons within a traditional public school at a point in time hold constant infraction policies and procedures, and isolate differences in behaviour. For these measures, we first compute the differences between each charter school entrant and her schoolmates who remain in the traditional public sector, and then average over the sample of entrants.

The high rate of charter school mobility shown previously, however, also means that the characteristics of new entrants may not accurately capture the overall degree of selection relevant for ongoing operations. Therefore while panel A of Figure 12 compares all charter school entrants to schoolmates who remain in the traditional public sector, panel B compares only charter entrants who remain in the charter school into the second year with the same set of schoolmates.

Figure 12 shows that following a dip between 2001 and 2002, average achievement of charter school entrants increased steadily relative to schoolmates who remained in the traditional public sector. The average difference in mathematics achievement between students who entered a charter school and schoolmates who remained in the traditional sector rose from -0.20 standard deviations in 2002 to 0.12 standard deviations in 2011; the corresponding rise for reading achievement is -0.11 to 0.17 standard deviations. Selection on achievement of entrants who remained in their charter schools into the second year following the transition shows slightly smaller improvement in mathematics but even larger improvement in reading (panel B of Figure 12). The similarity of the changes, however, indicates that it is selection for new entrants as a whole rather than differential persistence that drives the changes in composition by prior achievement.

Charter school entrants also become more positively selected in terms of the probability of having committed a disciplinary infraction. Again, it is the composition of new entrants that drives the change, as the relative rate of prior disciplinary infractions for students who persist in charter school remains stable during the period.

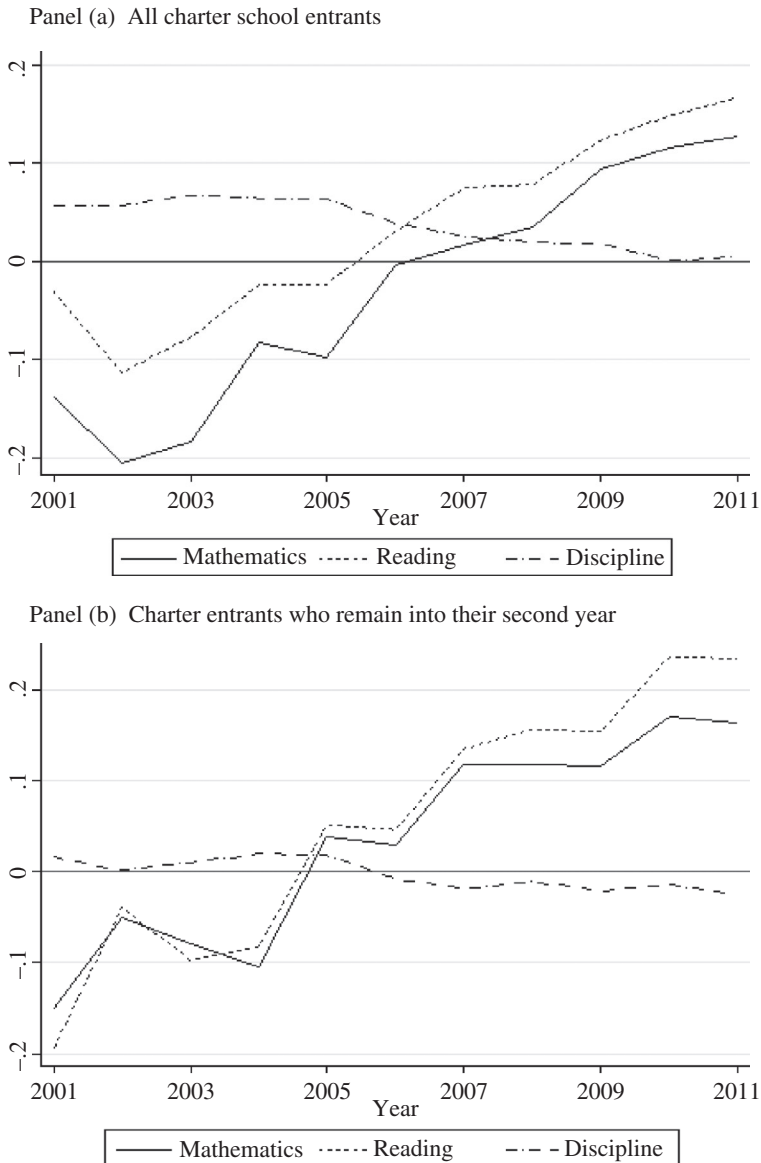


FIGURE 12. Trends over time in selection into the charter sector by prior mathematics and reading achievement and the probability of committing a disciplinary infraction, 2001–11.

Notes: These series compare students who transition to a charter school to their former schoolmates who remain at a traditional public school using information from the year prior to the transition. ‘Mathematics’ refers to average mathematics achievement, ‘Reading’ refers to average reading achievement, and ‘Discipline’ refers to the probability of having committed any disciplinary infraction.

Regression results

A pressing question facing policymakers is the extent to which increasingly positive selection accounts for the higher performance of charter schools overall and for schools that adhere to a No Excuses philosophy. To understand better the interrelationships

among mobility, selection and adherence to a No Excuses philosophy, we estimate a series of models that regress mathematics or reading value-added on various combinations of these variables.²⁸ Separate columns of Table 3 present estimates based on quality measures produced by both the statewide estimates and the matching models.²⁹

Panel A of Table 3 reports estimated effects on charter school value-added to mathematics achievement based on statewide (columns (1)–(4)) and matching (columns (5)–(8)) estimates of quality. The patterns are quite similar in each. Although the matching model coefficients are more than 50% larger than the corresponding statewide coefficients, all No Excuses coefficients are highly significant. Inclusion of the student turnover variable, also highly significant in all specifications, reduces the magnitude of the No Excuses estimate by roughly 20%. The addition of the selection variables leads to a further reduction of roughly 5%. In the full models (columns (4) and (8)), the No Excuses coefficient equals 0.075 in the statewide specifications and 0.12 in the matching specifications. Although the pattern is consistent with the possibility that lower turnover and more positively selected students account for a portion of the No Excuses effect, that portion appears to be relatively small.

Estimates for reading presented in panel B of Table 3 follow a similar pattern, though the inclusion of the selection variables leads to a somewhat larger decline in the No Excuses coefficient. In the statewide specifications, the coefficient declines from 0.047 to 0.031 while remaining significant at the 5% level; in the matching models, the coefficient declines from 0.050 to 0.029 and becomes insignificant. The larger and more significant effects for mathematics are consistent with the broader literature on school effects.

Although the specifications do not produce compelling estimates of the causal effects of the student composition variables, the findings illustrate the associations with school value-added. The coefficient on the turnover variable is highly significant in all subjects and specifications, while the coefficients on the prior achievement variables for entrants and persisters are all positive but are significant only in some specifications. This is not surprising given the multicollinearity introduced by including measures for both all entrants and those that remain for at least two years. We are particularly interested in the sensitivity of the No Excuses coefficients to changes in the controls, therefore we controlled comprehensively for student characteristics. Finally, there is little or no evidence that selection on prior disciplinary infractions inflates the No Excuses coefficients.

The large and significant mobility estimates, the sensitivity of the No Excuses coefficients to the inclusion of mobility, and the dramatic decline in the average share of students who are new to the school (Figure 11) suggest an important role for mobility in the improvement of the charter sector. One approach to quantifying that contribution is to use the causal estimate of mobility externalities from Hanushek *et al.* (2004), also based on Texas data, to estimate the contribution of mobility to the increase in charter school mathematics value-added. The estimate suggests that the approximately 20 percentage point decline in the charter–traditional public school differential in the share of students that are new to the schools contributes roughly 0.04 standard deviations to the improvement of charter school mathematics performance between 2001 and 2011.³⁰ Thus the greater sector stability *per se* accounts for over 17% of the decrease in the average mathematics value-added gap between charter and traditional public schools. Note that this is an estimate of the externality of high student mobility as the value-added regressions account for the direct effects of moving.

TABLE 3
ESTIMATED EFFECTS OF PROGRAMME CHARACTERISTICS AND STUDENT SELECTION ON CHARTER SCHOOL VALUE-ADDED

	Statewide estimates			Matching estimates				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>A. Mathematics</i>								
No Excuses indicator	0.0982*** (0.0273)	0.0796*** (0.0221)	0.0736*** (0.0234)	0.0748*** (0.0232)	0.155*** (0.0431)	0.134*** (0.0386)	0.123*** (0.0391)	0.121*** (0.0387)
Proportion new		-0.520*** (0.0483)	-0.496*** (0.0482)	-0.490*** (0.0493)		-0.587*** (0.0735)	-0.537*** (0.0720)	-0.546*** (0.0733)
Achievement difference								
Entrants			0.0170 (0.0235)	0.0111 (0.0232)			0.0801** (0.0387)	0.0856** (0.0399)
Persisters			0.0324* (0.0187)	0.0303 (0.0191)			0.0213 (0.0278)	0.0266 (0.0291)
Infraction rate difference								
Entrants				-0.0763 (0.0881)				0.0127 (0.112)
Persisters				0.0114 (0.0588)				0.0949 (0.0899)
Observations		1481				1459		

TABLE 3
CONTINUED

	Statewide estimates			Matching estimates				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<i>B. Reading</i>								
No Excuses indicator	0.0465*** (0.0147)	0.0368*** (0.0131)	0.0300** (0.0136)	0.0308*** (0.0134)	0.0504* (0.0267)	0.0377 (0.0249)	0.0293 (0.0254)	0.0287 (0.0251)
Proportion new		-0.272*** (0.0318)	-0.247*** (0.0320)	-0.243*** (0.0333)		-0.350*** (0.0586)	-0.316*** (0.0601)	-0.320*** (0.0584)
Achievement difference								
Entrants			0.0415** (0.0162)	0.0390*** (0.0165)			0.0489 (0.0354)	0.0518 (0.0367)
Persisters			0.0149 (0.0124)	0.0126 (0.0122)			0.0256 (0.0190)	0.0262 (0.0190)
Infraction rate difference								
Entrants				-0.0131 (0.0582)				0.0547 (0.104)
Persisters				-0.0350 (0.0406)				-0.0271 (0.0737)
Observations		1480				1459		

Notes

Estimates in columns (1)–(4) come from school-by-year level regressions with estimated value-added produced by the statewide comparison model as dependent variable. Estimates in columns (5)–(8) come from school-by-year level regressions with estimated value-added produced by the matching comparison model as dependent variable. Regressions include campus demographic characteristics and year dummies. All regressions are enrolment-weighted. Standard errors are clustered at the campus level. ***, **, * indicate $p < 0.01$, $p < 0.05$, $p < 0.10$, respectively.

Other contributing factors

Being classified as a No Excuses school is, of course, not the sole dimension of school operations. There are certainly others that vary, most notably the quality of leadership and instruction. In fact, conversations with executives employed by some of the largest CMOs operating in Texas reveal a strong emphasis on the hiring and development of effective school leaders. Some CMOs devote substantial resources to the identification and training of school leaders, including year-long apprenticeships. These preparation programmes differ considerably from one that would combine the traditional public school job ladder—teacher to assistant principal to principal—with some formal education in leadership. Other CMOs bemoaned the inability to afford such programmes. Importantly, this commitment to leadership did not seem to depend on the degree of authority granted over personnel or programmatic decisions. Impediments to the measurement of leadership performance complicate the identification of its contribution to charter school quality and improvement, and this is a prime area for further investigation.³¹

VI. CONCLUSIONS

This paper uses administrative microdata on schools and students to trace the evolution of charter school quality in Texas as measured by contributions to mathematics and reading achievement between 2001 and 2011. To do this, we construct quality measures using flexible value-added specifications that control for prior achievement and discipline. The analysis finds that charter school mathematics and reading value-added increased substantially relative to traditional public schools, driven strongly by voluntary and authorizer closure. This result is robust to whether the comparison group is composed of students in all traditional public schools in the state or only those from traditional public schools once attended by a charter school student. This improvement is notable because there is evidence that traditional public schools were also improving on average. The overall pattern of improvement is not a function of sampling or estimation methodology but appears to reflect market dynamics and effective regulation.

Two potential sources of these improvements stand out, namely an increasing share of schools that adhere to a No Excuses philosophy and a reduction in student mobility as the sector matures, although substantial portions of the improvement remain unexplained by these factors. The pattern of estimates suggests that more positive student selection and lower turnover account for some portion of the No Excuses premium but that the contribution is relatively small.

The substantial decline in student mobility, and the contribution of closures to charter sector gains, highlight the importance of patience in evaluating a large-scale educational reform, particularly one that relies on parental choices and market forces. The relaxation of constraints on school management induced many with little prior experience to apply for a charter, and the large variation in school quality observed during the early years is consistent with growing pains associated with a new market. These factors likely contribute to the high mobility and the unwillingness of many students making adequate progress in a traditional public school to consider switching to a charter school.

Over time, many low-performing schools closed, and the average effectiveness of new market entrants and schools remaining open throughout the decade rose. As might be expected, students and families appear to respond favourably to these improvements, as

selection into the charter sector became more positive and turnover declined. Thus the families of higher-achieving students appear to have elevated their opinion of a charter school as a viable alternative. Importantly, these responses likely amplified the sectoral improvements through improvements in the classroom environment.

The juxtaposition of these dynamic changes with cross-sectional comparisons of sector differences highlights the value of focusing on the trajectory of school quality rather than effectiveness at a point in time when evaluating a major educational reform. Much more can be learned about the behaviours of both families and education providers, and the aspects of school operations that contributed to the improvement. Although the identification of the contributions of specific school factors—including the quality of teachers, principals and CMO executives—may be difficult, this is a prime area for additional research.

ACKNOWLEDGMENTS

This work was done in conjunction with the Texas Schools Project at the University of Texas at Dallas. Ross Cole provided superb research assistance. The conclusions of this research do not necessarily reflect the opinions or official position of the Texas Education Agency, the Texas Higher Education Coordinating Board, or the State of Texas. We thank the American Institutes for Research and Institute for Education Sciences, US Department of Education, for financial support.

NOTES

1. Abdulkadiroğlu *et al.* (2011) and Angrist *et al.* (2012, 2013) report results for charter schools in and around Boston, and Dobbie and Fryer (2011) and Hoxby *et al.* (2009) report results for New York City.
2. See, for example, evidence from statewide studies in Bifulco and Ladd (2006), Sass (2006), Booker *et al.* (2007) and Hanushek *et al.* (2007). See also the multiple state comparisons in CREDO (2009, 2013).
3. Ladd *et al.* (2017) find that charter schools in North Carolina improve on average relative to traditional public schools following the approach used in an earlier version of this paper.
4. See US Department of Education (2014), Table 216.90 (http://nces.ed.gov/programs/digest/d13/tables/dt13_216.90.asp, accessed 2 November 2018).
5. Home-rule charter districts offer the possibility of increased flexibility for the entire district, but they also have a number of procedural requirements, including approval by local voters. The Dallas Independent School District had met the initial requirements and had a charter commission that was developing a charter for the voters, but the commission voted to stop the process in January 2015.
6. See tea.texas.gov (accessed 2 November 2018) for more information on state funding of charter schools.
7. Even though the at-risk requirements were modified, the charter sector has continued to enrol an increasingly larger share of poor students compared to the traditional public school sector.
8. A similar amendment is needed for a charter to change the grade levels that it serves or its geographic boundaries. See <http://ritter.tea.state.tx.us/rules/tac/chapter100/ch100aa.html#100.1033> (accessed 2 November 2018) for an up-to-date description of the statute.
9. See, for example, www.statutes.legis.state.tx.us/Docs/ED/htm/ED.12.htm (accessed 2 November 2018), which explains the procedure for placing charter operators on probation or revoking a charter.
10. A more detailed description of the underlying database can be found in Kain (2001) and other publications on the website for the Texas Schools Project (www.utdallas.edu/research/tsp-erc, accessed 2 November 2018).
11. Private school enrolment in Texas remains relatively small at less than 6% in 2011 (US Department of Education 2014). Moreover, in 2010 only 23% of people born in Texas had migrated to another state, making it the state with the lowest out-migration rate in the nation (Hanushek *et al.* 2017).
12. The TAKS exam was recently repealed by the Texas legislature, and schools will now transition to End of Course Exams.
13. Note, however, that students do not have to complete the tests to be included in the TAAS/TAKS file.
14. Estimates are virtually identical without this variable.
15. In follow-up papers, Rothstein (2017) asserts that bias in estimation remains, while in response Chetty *et al.* (2017) reject his test.
16. It may be that classroom placement of students is productive, that is, average student gains are higher in schools where student groupings and matches with teachers are optimal. For our analysis this is simply reflected in the overall school value-added, and we make no attempt to disentangle such sources of any differences in school value-added.

17. Student fixed effects provide another alternative approach to the identification of charter and traditional public school quality, as each student acts as his or her own control; see Bifulco and Ladd (2006), Sass (2006), Booker *et al.* (2007) and Hanushek *et al.* (2007). However, in models with student fixed effects, only students who attended schools in both sectors contribute to identification. Estimates based just on switchers may be particularly prone to biases introduced by time-varying student shocks. Moreover, in their study of variation in teacher value-added estimates, Guarino *et al.* (2015) find that the types of shocks typically considered problematic in this context appear to introduce less bias into value-added estimates produced by the lagged-achievement model than those produced by other models, including those with student fixed effects.
18. Note that Angrist *et al.* (2013) control for achievement in the year prior to charter school entry and estimate the effect of an additional year in a charter school on achievement. By comparison, we estimate separate specifications for each year and therefore use prior year test scores to account for underlying achievement differences regardless of how long a student has been attending a charter school.
19. The measure of the mean difference based on lottery data would weight each school based on its sector enrolment share of compliers with the lottery results.
20. Variation over time in the composition of schools that hold lotteries also changes the control group of traditional public schools.
21. The findings in Gleason *et al.* (2010) illustrate the possibility that changes over time in the distribution of traditional public schools can alter estimates of charter school effects. First, the lottery-based method generates substantial heterogeneity in estimated charter school effects. Second, the estimated effect of charter school attendance is much higher for low-income students. This finding is consistent with the possibility that the gains from charter school attendance are likely higher in areas with lower-quality traditional public schools (assuming that school quality tends to be lower as poverty increases). Some of the observed variation almost certainly reflects heterogeneity in charter school effects, but the pattern is consistent with the existence of heterogeneity in traditional public school quality as well.
22. A concern here is that differences in the number of years schools had been in operation may also contribute to the changes in value-added. We investigated differences by years of operation using a school fixed effects estimator. The results (not reported) revealed little evidence of systematic differences in average value-added by years of operation, among schools not in their first year of operation.
23. Preliminary analysis that examined the association between CMO quality as measured by prior average value-added found only weak evidence of a negative relationship between CMO quality and the probability of reducing the number of schools operated, and little or no evidence of a positive relationship between CMO quality and the probability of expansion.
24. NAEP is a national test, often called the 'nation's report card', given to representative samples of students in all states. It has reported state performance in mathematics and reading at grades 4 and 8 every two to four years since 1992. Eighth-grade reading tests were not available until 1998. See <https://nce.s.ed.gov/nationsreportcard> (accessed 2 November 2018).
25. Note that schools across the country also tended to improve on these tests over the period, perhaps indicating the impact of federal accountability legislation (No Child Left Behind, or NCLB). Nonetheless, Texas students as a whole and across the racial/ethnic subgroups generally improved more than the national average over this period.
26. See the review in Sacerdote (2011).
27. Nichols-Barrer *et al.* (2014) consider the conjecture that student attrition from Knowledge is Power Program (KIPP) schools might explain their success, but reject it.
28. For this analysis, the selection at the time of entry and re-enrolment variables are computed as follows. First, each charter school entrant is assigned the difference between their prior achievement (or liability of a disciplinary infraction) and the average among their traditional public school peers that remain in the traditional public sector. Next, these differences are averaged over all students that enter each school. The re-enrolment selection variables are computed similarly, with the exception that the differences are averaged over only those students who remain in the same charter into their second year. For students who enter a charter school in year t , the degree of selection on entry is related to value-added in year t , while the degree of selection at the time of re-enrolment for the second year is related to value-added in year $t + 1$. Standard errors are clustered at the school level; clustering at the CMO level has little effect on the standard errors.
29. Because of the computational intensity of estimating standard errors for all school fixed effects, the regressions are weighted by enrolment rather than the inverse of the standard errors. Regressions weighted by the inverse of the standard errors using a single year of data were qualitatively and quantitatively similar to those weighted by enrolment, and the correlation between the alternative weights exceeded 0.7 in all subjects and methods.
30. Hanushek *et al.* (2004) find that the added disruption of high mobility creates an externality. That analysis is based on value-added models of achievement in Texas which include student, school-by-year and school-by-grade fixed effects to account for confounding factors, including perceived school quality and neighbourhood shocks. A 10 percentage point higher level of mobility reduces mathematics achievement by approximately 0.02 standard deviations in Texas public schools (independent of any impact on the individuals who move). Note that estimates of the impact of mobility externalities are not available for reading.

31. See Branch *et al.* (2012) and Laing *et al.* (2016) on both the potential importance of principals and the difficulty of measuring differences among principals. Bloom *et al.* (2014) also point to the importance of management in schools, relying on surveys of specific management practices. England has introduced Academy Schools, which call for conversion of traditional public schools into institutions very similar to charter schools, and this has led to positive but heterogeneous impacts on student performance. When surveyed, a majority of the Academy Schools indicated that change in leadership was the most important element of their conversion; see Eyles and Machin (2018).

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APPENDIX: CLASSIFICATION OF SCHOOLS AS ADHERING TO THE NO EXCUSES PHILOSOPHY

We used a number of sources of information to determine whether a CMO adhered to the No Excuses philosophy. First, our research assistant called each school, described our project, and asked the representative if they could answer some questions about the school's approach to education. This often proved difficult, as many representatives offered vague or curt responses. The research assistant then explored the website (if available), focusing on the mission or vision statements, superintendent's message, history, and other relevant information to gain a general feel for the school. Perhaps the most important source of information was the school handbook and code of conduct, and the research assistant carefully sifted through these documents. Finally, if none of these sources proved adequate, then the research assistant searched for school reviews and articles that provided information on school policies and practices.

We focused on six areas to determine whether to classify a school as adhering to the No Excuses Philosophy. These areas are as follows.

- **Discipline:** Most schools follow a progressive disciplinary system and provide clear expectations for behaviour. Some schools, however, stand out as being particularly strict. We classify schools as strict in the discipline dimension if they use corporal punishment, impose strict zero tolerance policies for misbehaviour, use curfews, have fine dining requirements (no talking or sharing), impose sizeable monetary fines for having cell phones or electronics, or undertake legal prosecution if a teacher is offended by students' language or other actions.
- **Expectations:** We use the following questions to determine whether a school sets very high expectations. Does the school hold all students to the same high expectations regardless of extraneous circumstances or family background? Does the school follow state standards or hold their students to higher expectations? (That is, are students required to meet the state-required 90% compulsory attendance or does the school require *all* students to maintain 95–100% attendance to stay enrolled?) Does the school require that all students are accepted at a university? Are students expected to graduate from college?
- **Uniforms:** Does the school require students to wear uniforms? Is there adherence to a strict dress code? Are there serious consequences for failing to comply? Are students sent home, fined or given detention? How many infractions need occur before there is a serious consequence?
- **Parental involvement:** Are parents encouraged to actively participate in the school? Are parents required to sign a commitment form?
- **Incentives:** Does the school offer rewards to students who surpass expectations? Most schools recognize students through things such as an honour roll, by allowing them to go on field trips, or by letting them have a free dress day. Some offer additional incentives such as monetary prizes or privileges for good grades or attendance, and have a strong belief in reinforcing good behaviour.
- **Extra:** Is there an extended school day, week or year? Is Saturday school offered or required? Is there any tutoring?

For some CMOs that were consistent across categories, the classification decision was straightforward. For other CMOs, the decision was more difficult, because they appeared to be strict in some dimensions but not others. In classifying these schools, we placed particular emphasis on the strictness of the disciplinary practices.