

THE QUALIFICATIONS AND CLASSROOM PERFORMANCE OF TEACHERS MOVING TO CHARTER SCHOOLS

Celeste K. Carruthers
University of Tennessee

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Abstract

Do charter schools draw good teachers from traditional, mainstream public schools? Using a 1997-2007 panel of North Carolina public school teachers, I find nuanced patterns of teacher quality flowing into charter schools. High rates of inexperienced and uncertified teachers moved to charter schools, but among certified teachers changing schools, the on-paper qualifications of charter movers were better or no different than the qualifications of teachers moving to comparable mainstream schools. I estimate measures of classroom performance for a subset of grade 3 - 5 teachers, and show that charter movers were more effective in math and reading instruction, relative to other mobile teachers. Charter movers compared less favorably, however, to non-mobile teachers and colleagues within their sending schools.

1. Introduction

Charter schools are independently operated public schools, free from many of the district and state regulations faced by traditional, mainstream public schools. Forty states and the District of Columbia have legislation outlining the establishment, operation, and accountability of charter schools. A charter program represents a new, competitive branch of publicly funded education that entrusts each campus with a degree of autonomy rarely seen in mainstream schools. Autonomy and flexible resource allocation in charters schools may draw good teachers away from the mainstream. A growing body of research has characterized the qualifications of the stock of charter teachers, who compare favorably to mainstream teachers in some respects (college selectivity, for instance) but not others (experience, certification). I complement and advance this literature by analyzing the qualifications and classroom performance of the flow of North Carolina teachers moving from

mainstream to charter schools over the years 1997-2007.¹

Charter schools, playing the role of competitive entrants in partially deregulated public education markets, are expected to spur efficiency gains by decreasing industry concentration and challenging incumbents (here, traditional public schools) to improve performance. Proponents of charter schools, and school choice more generally, expect competition between traditional and choice schools to drive up the quality of education overall. Friedman (1955, 1997) proposed vouchers as one way to stoke school competition. Dee (1998), Hoxby (2003), and most recently, Booker, Gilpatric, Gronberg, and Jansen (2008) offer empirical evidence that mainstream student performance improves in light of competition from choice schools. Long-run gains from competition will require charters to be formidable competitors, however, and charter programs have delivered mixed results. Enrolling in a new charter school appears to have a negative impact on student achievement growth, but this penalty fades (and in some settings, reverses) as schools and students gain experience.²

Teacher quality is a profound factor in student achievement,³ and charters seeking to produce high achievement (or at least, meet accountability standards) will value effective teachers. Charter schools are heterogeneous by nature; some specialize in priming the gifted and college-bound,

¹I refer to school years by the year of their conclusion. For instance, 2007 references the 2006-2007 school year.

²See, e.g., Bifulco and Ladd (2006), Booker, Gilpatric, Gronberg, and Jansen (2007), Hanushek, Kain, Rivkin, and Branch (2007), and Sass (2006).

³Rivkin, Hanushek, and Kain (2005) and Rockoff (2004) find that an increase of one standard deviation in teacher quality increases student achievement by about ten percent of a standard deviation.

while others target students at risk of failure. Recruiting and retaining high-quality teachers will be more difficult for the latter group. The teacher mobility literature is thick with evidence of teacher preferences for high-performing and socioeconomically advantaged school environments.⁴

Charter schools may have an advantage in the teachers' labor market, regardless of their student composition. "They are free to recruit the best teachers and to raise money from foundations, corporations, and individuals" (Manuel, 2007). Charters are not generally bound by state pay scales, they can allocate budgets as they see fit, and feasibly, they can pay higher teacher salaries. One New York City charter school famously offers teacher compensation packages in excess of \$125,000 (Gootman, 2008). Nationwide, charter teacher salaries are comparable to mainstream salaries,⁵ but in some states, charter teachers earn significantly less than other public school teachers with similar qualifications (Malloy and Wohlstetter, 2003). Even if charter schools cannot outbid mainstream schools on salary alone, school leaders can influence teachers' utility in non-pecuniary ways, by reducing their non-instructional duties, encouraging collegiality among faculty,

⁴Findings were fairly consistent across source data and specifications: teachers were more likely to exit schools with larger proportions of black students (but to a lesser degree for black teachers) or lower student achievement. See Clotfelter, Ladd, Vigdor, and Diaz (2004), Hanushek, Kain, O'Brien, and Rivkin (2005), Falch and Strøm (2005), and Scafidi, Sjoquist, and Stinebrickner (2007).

⁵Nationally, charter teachers had an average salary of \$37,000 in 2004, versus \$44,500 for traditional public school teachers. The pay gap coincided with a substantial experience gap: 43.4 percent of charter teachers had three or fewer years' experience, compared to just 17.1 percent of mainstream teachers (National Center for Education Statistics, 2006). Podgursky and Ballou (2001) and Hoxby (2002) also found competitive teacher salaries in charter schools.

manipulating class size and composition, and granting teachers more creative license and autonomy than they are afforded in mainstream schools. Early advocates of the charter model stressed the professionalization and empowerment of teachers as critical tenets of charter development (see, for example, Budde (1988) and Kolderie (1990)).

In practice, the intangible benefits of working in a charter school may be too low to offset low pay and other resource limitations. Common charter finance models allocate each school a per-pupil rate roughly equal to the surrounding district's average per-pupil cost, excluding the cost of buildings. If a district enjoys substantial economies of scale in variable cost, its per-pupil expenses will be less than a charter school's average cost. Charters with competing uses for limited resources may sacrifice some teaching talent in favor of administrative and capital improvements if doing so maximizes their objectives (student achievement, enrollment, and budget size being likely objectives). Furthermore, many states allow charters to employ a high rate of uncertified teachers. This permits charters to attract teachers from outside the traditional pipeline, but also increases the supply of low-cost, low-skilled individuals eligible to work in charter schools, including uncertified mainstream teachers nearing the expiration of temporary licenses. Recently, Wisconsin raised subject-based certification requirements for its charter teachers, prompting school leaders to argue that they could not afford to hire teachers meeting the new standard (Borsuk, 2008). Charter licensure requirements vary across states, and little is known about the qualifications of uncertified teachers in charter schools, or the impact of relaxed licensure standards on student performance in charter schools.

Much of the developing research on charter teacher quality examines the qualifications, workload, and job satisfaction of the stock of charter teachers nationwide or within particular states. Podgursky and Ballou (2001) surveyed teachers in seven states, and found that charter teachers

were less likely to be certified, more likely to be inexperienced, and more likely to have merit pay than mainstream teachers. Hoxby (2002), using a 1998 national survey of teachers, showed that charter teachers had typically taken more math and science courses in college, were more likely to have graduated from a good college, and logged more extracurricular hours. Interestingly, charters paid a premium for these qualities, but not for certification or master's degrees. Taylor (2005) also failed to find a premium for advanced degrees in Texas charter schools, and showed that charter teachers earned 7.5 less than mainstream teachers with similar experience and education.

While a picture of teacher quality in charter schools is emerging, little is known about the flow of teaching talent between mainstream and charter schools, or the classroom performance of individual charter teachers. Here, I fully characterize the resume qualifications of all North Carolina public school teachers who moved to the charter sector between 1998 and 2007. For a subsample of elementary teachers, I characterize their classroom performance as well. North Carolina is a rare setting where passively collected administrative data include longitudinal school assignments for all charter and mainstream personnel over a period exceeding ten years. Furthermore, the data link some teachers directly to their students, permitting measures of teacher quality. By analyzing the flow of teachers from one sector to another, I determine whether charter schools were “cream skimming” good teachers from mainstream schools. If highly qualified and effective teachers were voting with their feet in favor of charter schools, their migration is a favorable signal of the decentralized model's appeal, and mainstream schools may need to emulate charter features to retain faculty. If charters were drawing less qualified and less effective teachers, whether because of low pay, poor organization, or relaxed licensure standards, the charter model is unlikely to fulfill its promise as a revolutionary vehicle for the improvement of public schools.

I evaluate the resume qualifications of North Carolina charter movers against the qualifications

of teachers moving between mainstream schools, controlling for receiving school profiles. Charter movers were less experienced than other moving teachers on average, but were also more likely to have at least twenty-five years' experience. Charter schools were attracting teachers with high licensure test scores, but only among certified, regularly licensed teachers. Uncertified teachers moving to charter schools, a large minority, substantially attenuated the average qualifications of all charter movers. Resume qualifications are, at best, incomplete signals of teacher quality. For a subset of elementary grade teachers, I evaluate their classroom performance directly, by estimating teachers' fixed effects on end-of-grade math and reading exams. Charter movers were low in sending school distributions of classroom performance, relative to their colleagues, but compared favorably to teachers moving to similar mainstream schools. I complement these estimated mean differences in teacher quality with analyses of the variance and distribution of teacher quality, dissected from the variance in sampling error. Quality distributions for future charter teachers largely overlapped quality distributions for exclusively mainstream teachers, but were centered at significantly lower figures.

These findings neither affirm nor reject the effectiveness with which North Carolina's current charter model draws good teachers from mainstream schools. The system attracted highly qualified, certified, and effective teachers, but low licensure requirements attracted uncertified, less qualified teachers who may have had few career options in the mainstream sector.

2. Charter Schools in North Carolina

2.1. Background

North Carolina is an ideal setting to study charter teacher mobility. The state's charter system is eleven years old, its schools are spread throughout urban, rural, and socioeconomically diverse regions of the state, and extensive data (described fully in section 2.2.) have been collected over

an eleven-year period for all mainstream and charter teachers in the state. These data allow me to characterize the on-paper qualifications of every teacher moving to the state's charter sector, and to estimate the classroom performance of many elementary charter movers. Charter legislation and oversight in North Carolina (described below) bear many features in common with other states' charter systems. But the state has a 100-school cap, and accordingly, a very small percent of teachers moved to charter schools in a given year. The comparison group – mainstream teachers moving to other mainstream schools – was large and varied, as were the schools they moved to, so charter and mainstream movers have common support for identification of their relative quality. The comprehensive treatment of all charter data in the state, together with the unique ability to estimate teachers' individual classroom performance over several years, makes North Carolina the best available setting for the purposes of this study.

The North Carolina legislature authorized the state's system of charter schools in 1996. One objective of the system was to create new professional opportunities for teachers.⁶ The state's first thirty-four charter schools opened for the 1998 school year. By 2006, there were more than 27,000 students enrolled in charter schools, accounting for 1.9 percent of statewide enrollment. Figure 1 illustrates the widespread geographic range and concentration of charter enrollment in 2006. Charters were active throughout the state, though less so in the rural eastern counties. Four of the state's largest counties – Durham, Forsyth, Mecklenburg, and Wake – had the largest charter presence in terms of absolute enrollment. But as the second panel illustrates, charter penetration was high in several suburban and rural counties outside of the major population centers.⁷

The application, approval, and evaluation of charter schools is closely regulated, but the schools

⁶NC Gen. Stat. 115c-238.29a (1996)

⁷The State Board of Education limits annual charter growth within any one district.

are given wide latitude in their personnel management and daily operations. North Carolina charter schools are organized as private, nonprofit organizations.⁸ They are allotted funding from state and local boards of education on a per-pupil rate, commensurate with district per-pupil costs. There are restrictions, however, on how government allotments can be used for real property and classroom facilities.⁹ Charters can raise additional funds by winning grants or soliciting donations, but they cannot charge tuition. Financial difficulties are common in North Carolina's charter schools. Twenty-four charters were relinquished or revoked between 1998 and 2006; of those, nine cited financial problems as a leading cause of failure.

A distinctive feature of North Carolina's charter school system is a pronounced *de facto* racial segregation.¹⁰ Just over half of the state's charter schools had racially imbalanced student populations, meaning that the percent of students who were nonwhite was twenty percentage points above or below the county-wide share of nonwhite students. By comparison, just one-quarter of mainstream schools were racially imbalanced. A charter schools is required to "reasonably reflect the racial and ethnic composition of the general population"¹¹ residing in the surrounding district (which, for most schools, is a county district). Exception is given to schools serving a targeted pop-

⁸The nonprofit requirement does not preclude for-profit education management organizations like KIPP from granting franchises in North Carolina.

⁹State funds may be used to lease property, facilities, and equipment for charter schools, but not for "any other interest in real property or mobile classroom units." Loans made to charter schools do not have the backing of any taxing authority. (NC Gen. Stat. 115C-238.29H(a1) (1996))

¹⁰Bifulco and Ladd (2006) fully explored the segregating effects of North Carolina's charter program.

¹¹NC Gen. Stat. 115C-238.29F(g)(5) (1996)

ulation, in which case, their student body is required to resemble the racial and ethnic composition of the local target population. Many charters target gifted or at-risk students, two groups which are overrepresented by white and nonwhite students, respectively, and so the segregation of the state's charter schools is an unsurprising, albeit unforeseen, consequence of the program's design.

Charter schools are held to the same accountability model as mainstream public schools, with some exceptions for new charters. Each year, state administrators calculate a performance composite for each campus, interpreted as the percent of students who performed at grade level. Charters were well-represented at both extremes of the performance composite distribution. In 2006, for instance, charters were 2.6 times as likely as mainstream schools to have performance composites below 50,¹² and 2.3 times as likely to have performance composites above 90. The wide variance in racial composition and student proficiency among charter schools underscores the importance of controlling for student body composition and school-wide performance when evaluating the quality of teachers who moved to charter schools. Each school's profile would have affected the type of candidates willing to work there.

Charter schools are allowed great flexibility in the recruitment, retention, and pay of their faculties. The state imposes very little regulation on who can teach in a charter school. At least 75 percent of charter teachers in kindergarten through fifth grade classrooms must hold teaching

¹²Schools with consecutive sub-50 performance composites that fail to make expected growth benchmarks must collaborate with evaluation teams assigned by the State Board of Education to develop corrective action plans. Charters with sub-60 performance composites for three consecutive years are denied 10-year renewal. (North Carolina State Board of Education 2006, EEO-U Series)

certificates. This number falls to 50 percent for charter teachers of grades six through twelve. Uncertified teachers are much less common in mainstream schools. Only certified teachers are eligible for tenure after four consecutive years of teaching in a mainstream public school. Tenured mainstream teachers who wish to teach in a charter school are granted one year's leave, meaning that they can return to their original school after a year, space permitting. Charters are not required to offer tenure, nor are they required to participate in the state retirement plan.

Low licensure requirements for charter faculties were put in place to attract new, nontraditional teachers from fresh sources - non-teaching vocations, Teach for America, and so forth. Recent work by Kane, Rockoff, and Staiger (2008) and Boyd et al. (2006) suggest that within schools, there is little difference in quality between certified, alternatively certified, and uncertified teachers.¹³ States vary in their treatment of teacher licensure in charter schools. Of the forty states with active charter systems in 2008, fifteen required all charter teachers to be certified. Others, like North Carolina, held each faculty to a minimum percentage. Only Arizona, Washington, D.C., and Texas placed no restrictions on charter teacher certification.¹⁴ (Center For Education Reform, 2008)

2.2. Data

I use data covering the universe of North Carolina public schools, students, and teachers. The data are maintained by the North Carolina Education Research Data Center at Duke University, in

¹³We would expect this to be true within schools if administrators hire equivalently skilled candidates regardless of licensure. It may be the case, however, that low licensure standards put downward pressure on the across-school distribution of teacher quality.

¹⁴In Texas, just 31.4 percent of charter teachers were certified in 2004 Taylor (2005).

collaboration with the state Department of Public Instruction.¹⁵ I assembled a richly detailed panel describing teachers' credentials, work environments, and career paths over the years 1997 - 2007. Gender, race, and school assignments were available for all teachers – including, importantly, charter teachers. I excluded teachers assigned to multiple schools in any one school year,¹⁶ as well as teaching assistants and facilitators. I linked each teacher's school assignment to campus-wide statistics derived from the NCES Common Core (grades served, school age, and quintile indicators for student body demographics and proficiency). Teacher credentials – experience, education, type of licensure, and licensure test scores – were only available for mainstream teachers, so I cannot characterize the qualifications of charter teachers *per se*. But the data allow me to identify teachers who moved to charter schools, affording a unique insight to the flow of labor between sectors.

Two features of North Carolina public school data are especially valuable for this study. First, I can track teachers as they change schools and evaluate teachers' resumes at the point when they moved to a new school or opted into the charter sector. Second, many mainstream elementary students can be reliably matched to their classroom teacher. I utilize this link between the inputs and observable production of student achievement to estimate teacher fixed effects. Thus, for a subset of mobile teachers, I evaluate their classroom performance in addition to on-paper qualifications.

Table 1 describes teacher mobility patterns between charter and mainstream schools for the 5,346 teachers who were working in a charter school at some time between 1998 and 2007. The majority taught exclusively in charter schools while one-third taught in a mainstream public school before moving to a charter. Of these, 1,142 moved directly to a charter school, without leaving

¹⁵See Muschkin, Bonneau, and Dodge (2008).

¹⁶This affected a non-trivial percent of teacher-year observations (6.1), including teachers with roving assignments and teachers who switched schools mid-year.

the panel between schools. I focus on direct movers in my main analyses, although results are qualitatively similar under more liberal definitions of teacher mobility. I evaluate charter movers against other mobile teachers, therein avoiding selection biases from omitted variables driving mobility itself. Results shed light on the quality and qualifications of teachers flowing into charter schools, and implicitly, the degree to which charter schools competed for good teachers.

3. Analytic Methods and Results

3.1. Qualifications of Teachers Moving to Charter Schools

Table 2 lists summary statistics for the 1997 - 2007 panel of North Carolina's mainstream public school teachers. I determined the highest degree attained by each teacher: 30.8 percent of teachers held a post-baccalaureate degree of some kind. A teacher's degree-granting institution was "competitive" if it was classified as such (or "competitive plus," "very competitive," etc.) by the 1995 edition of *Barron's Profiles of American Colleges*.¹⁷ Just over three-quarters of North Carolina teachers graduated from a competitive college or university. North Carolina teachers take a variety of licensure exams, most of which are in the Praxis family. In order to include all available test information, I scaled raw licensure test scores to have a mean of zero and standard deviation of one within each test code and test year. I calculated the mean standardized licensure test score for each teacher, equal to the average of all of her unique exams records.¹⁸ Regularly licensed teachers, who accounted for 89.5 percent of all teachers, had completed an approved teacher education and testing program, or attained licensing by reciprocal or interstate agreement. The complements to

¹⁷The 1995 edition roughly corresponds with the graduation date of mobile teachers with six years (the median) of experience.

¹⁸Although exams were scaled to have mean zero, teacher test scores were positive on average (0.030). This is probably due to selective survival and longevity among active teachers.

regularly licensed teachers were uncertified teachers holding temporary, emergency, or provisional licenses.¹⁹ Years of experience were derived from pay level codes. Although teachers had 11.93 years of experience on average, 26.1 percent had no more than three years' experience.

Mobile teachers, summarized in the second column of Table 2, were earlier in their careers, on average, and less likely to have graduate degrees than teachers who were not changing schools.²⁰ Mobile teachers had lower licensure test scores than non-movers, by 0.015 standard deviations. Mainstream teachers moving to charter schools, summarized in the fourth column of Table 2, were typically less qualified than other moving teachers. Charter movers were 4.5 percentage points less likely to have graduated from a competitive college or university, and 9.9 percentage points less likely to be regularly licensed. North Carolina's policy of permitting more uncertified teachers in charter schools may have had the consequence of drawing untenured mainstream teachers nearing the expiration of their temporary licenses. I observed 1,142 teachers moving directly to charter schools - of these, 20.9 were uncertified, nearly twice the rate of uncertified teachers moving to

¹⁹In compliance with the federal No Child Left Behind Act, all North Carolina teachers of core subject areas were to be "Highly Qualified" by June 30, 2006. With some exceptions, Highly Qualified teachers are fully licensed, hold at least a bachelor's degree, and demonstrate competence in each subject they teach. For mainstream elementary teachers, this effectively eliminated every alternative licensure path, including lateral entry. But North Carolina, along with nine other states and the District of Columbia, failed to make adequate progress toward staffing every class with a Highly Qualified teacher by the 2007 school year, and no state made total progress (Feller, 2006). I find virtually no change in teacher certification rates in the later years of the panel.

²⁰A mobile teacher is defined throughout as one observed in school a in year t and school $a' \neq a$ in year $t + 1$.

another mainstream school.

Charter movers were less experienced than mainstream movers, by 1.47 years on average, and were 11.4 percentage points more likely to have three or fewer years of teaching experience. The rate of nonwhite teachers was much higher among charter movers (26.4 percent) than among mainstream movers. Charter movers did, however, have higher licensure test scores than mainstream movers, and were somewhat more likely to have at least twenty-five years' experience. Figure 2 illustrates comparative kernel densities for the teaching experience of mobile teachers. Charter movers were more likely to have just a few years of experience, relative to mainstream movers. They were also more likely to have around 30 years of experience. In the lower panel of Figure 2, limited to regularly licensed movers, the bimodality of charter teachers' experience is more pronounced.

Before turning to the parametric analyses of charter movers' qualifications, a better understanding of the schools these teachers were moving between is warranted. If charter movers were highly qualified relative to other mobile teachers, but leaving low-performing schools, this would have very different policy implications than if less qualified teachers were leaving high-performing schools. I calculated the change in performance composite – the percent of students performing at grade level – between a mobile teacher's new and old school. Mainstream movers typically realized a 1.9 percentage point increase in proficiency upon changing schools, but charter movers realized a 0.2 percentage point loss. This suggests that teachers were not exploiting the charter sector to “trade up” to relatively high-performing schools. Mobile teachers moved to schools with higher rates of white students, regardless of whether they were moving to a charter or mainstream school, but this pattern was much more pronounced for charter movers. Teachers moving to charter schools realized a 9.2 percentage point increase in the rate of white students, on average, compared

to 3.7 percentage points for mainstream movers.

Summary evidence from Table 2 and Figure 2 do not permit the conclusion that charters were attracting more or less qualified teachers than *similar* mainstream schools. Toward that end, I conduct more parametric analyses of charter and mainstream movers by estimating Equation 1 via ordinary least squares for each North Carolina teacher j observed in year t (1997-2007), school s , and county l :

$$Q_{jslt}^k = \delta_{jt}^m \mathbf{1}(moving) + \delta_{jt}^c \mathbf{1}(tocharter) + \mathbf{X}_{jsl(t+1)}^r \theta^r + \alpha_{l(t+1)} + \varepsilon_{jslt} \quad (1)$$

Equation 1 is a reduced form expression for qualification k , where k indexes the on-paper qualifications summarized in Table 2: graduate degree, competitive college education, mean licensure test score, regular licensure, and three measures of experience.²¹ All mobile teachers had the indicator $\mathbf{1}(moving)$ equal to one. Teachers moving to a charter school additionally had $\mathbf{1}(tocharter)$ equal to one. The coefficient $\hat{\delta}_{jt}^m$ is the estimated difference in k between mainstream movers and non-movers. The coefficient of interest is $\hat{\delta}_{jt}^c$, the estimate difference in qualification k between

²¹Equation 1 was estimated separately for each qualification k . An alternative would have been to project teachers' mobility onto the space of their qualifications and sending school characteristics to get a sense of the factors affecting the supply of charter school teachers. I emphasize the reduced-form empirical strategy to underscore the descriptive inference gained by examining a relatively small set of idiosyncratic labor decisions. As a robustness check, I also estimated a multinomial logit equation predicting the likelihood of different types of school changes. Results suggested that the relative risk of moving to a charter school significantly increased for less experienced and unlicensed teachers, and significantly decreased for teachers with higher licensure test scores. These findings are in agreement with the reduced-form results to follow.

teachers moving to charter and mainstream schools. Controls included receiving school characteristics ($\mathbf{X}_{jst(t+1)}^r$), dummy variables for missing school data, and receiving county-by-year effects ($\alpha_{l(t+1)}$).²² Receiving school characteristics included dummy variables representing student body size and composition quintiles (the percent who were nonwhite, the percent performing at grade level, and total enrollment), the range of grades served, and a set of dummy variables controlling for missing data. County-by-year effects controlled for unobserved heterogeneity in regional variables, like non-teaching job opportunities. Robust standard errors allowed for clustering within each sending school and year. If charter schools had higher demand for some qualifications, and were able to outbid mainstream schools by manipulating employment terms and working conditions, then $\hat{\delta}_{jt}^c$ would be positive. If charters had lower demand, or were unable to realize an advantage in the teachers' labor market, then $\hat{\delta}_{jt}^c$ would be insignificant or negative

More experienced teachers may seek graduate degrees or additional certifications to increase their pay, so I controlled for teacher experience categories (indicators for less than three years' experience or more than twenty-five years' experience) when estimating Equation 1 for licensure and education variables. Since licensed and unlicensed teachers may have different incentives to consider charter schools, I produced separate estimates of δ_{jt}^m and δ_{jt}^c for the subsample of licensed teachers.

Table 3 lists estimates of δ_{jt}^c and δ_{jt}^m for each resume qualification.²³ Columns I and II present

²²Results were qualitatively similar when I controlled for sending and receiving school characteristics. Specifications with receiving school characteristics alone are preferred; in this context, the “pull” of particular school environments is of greater interest than the “push” from sending schools.

²³Unreported coefficients for school variables were largely unsurprising. Relative to schools in

results from the full sample. Column I lists coefficient estimates for δ_{jt}^m , the typical difference in qualification k between teachers moving to mainstream schools and non-moving teachers. Estimates of δ_{jt}^m serve as the baseline to which δ_{jt}^c estimates are compared. Movers were significantly different than non-movers with respect to each qualification, with the exception of graduate degrees. Movers were much less experienced, by 3.69 years on average, than their non-moving counterparts. They were 13.2 percentage points more likely to have three years' experience or less, and 10.2 percentage points less likely to have at least twenty-five years' experience.

Column II coefficients in Table 3 answer the question, "were charter movers more or less qualified than teachers moving to comparable schools?" The qualifier is important, given the heterogeneity of charter school working environments. With respect to graduate education, licensure, and years of experience, charter movers were significantly less qualified. They were 2.7 percentage points less likely to hold a graduate degree, echoing findings by Hoxby (2002) and Taylor (2005). Charter movers were much less likely to be licensed than other mobile teachers, by 7.4 percentage points. Mainstream movers were themselves less likely to be licensed, relative to non-movers, so point estimates from the licensure equation suggest that charter movers were 8.6 percentage points less likely to be licensed than non-moving teachers. Charter movers were less experienced than mainstream movers by 1.07 years, but *more* likely to have at least twenty-five years' experience.

the top quintile of student achievement, teachers in lower-quintile schools had weaker qualifications. The same could be said for teachers going to schools in the higher quintiles of percent nonwhite students, with the exception of graduate degrees. Teachers in schools with higher proportions of non-white students were more likely to hold a graduate degree. High school teachers tended to have higher qualifications, relative to middle and elementary school teachers.

This is in agreement with the bimodal pattern of experience seen in Figure 2.

Fully licensed teachers may have had more options in the mainstream sector than unlicensed, untenured teachers. Accordingly, licensed teachers' mobility decisions better reflect revealed preference. Columns III and IV list results from the subsample of licensed teachers, who accounted for 89.0 and 79.1 percent of mainstream and charter movers, respectively. Limiting the sample had little effect on results for mainstream movers; point estimates were not economically different between columns I and III. But excluding unlicensed teachers from the analysis substantially affected conclusions about the relative qualifications of charter movers. In contrast to column II, column IV results show that licensed charter movers were not statistically different than licensed mainstream movers with respect to graduate degrees or years' experience, although they were 4.9 percentage points more likely to have at most three years' experience. The difference between the full and limited sample was particularly stark for licensure test scores. Licensed teachers moving to charter schools had significantly higher licensure test scores than other moving teachers, by 9.4 percent of a standard deviation.²⁴ By comparison, licensed mainstream movers had lower test scores than

²⁴Charter movers had significantly higher rates of missing licensure test data than mainstream movers (11.8 and 7.8 percent, respectively), though less so if they were licensed (5.5, 4.0). I simulated various counterfactual scores for teachers with missing data to gage the sensitivity of charter movers' test score advantage. The result that licensed charter movers had significantly higher test scores was robust up to a 0.5 standard deviation penalty for charter movers with missing test data (relative to mainstream movers with missing data). More than a 2.0 standard deviation gap was necessary to produce the result that licensed charter movers had significantly lower test scores than mainstream movers.

licensed non-movers, by 2.3 percent of a standard deviation.

It is sensible that charter schools would have attracted teachers with higher licensure test scores. Conditional on licensure itself, test scores were not rewarded in the state's pay scale. Yet a teacher's test scores are significant (albeit weak and noisy) indicators of how well his or her students will do on their own tests. Goldhaber (2007) and Clotfelter, Ladd, and Vigdor (2007) showed that North Carolina teachers with higher licensure test scores were associated with greater student achievement on end-of-grade math and reading exams. Master's degrees, which result in permanent ten percent raises for North Carolina mainstream teachers, were not robust indicators of student performance in either aforementioned study. Charter schools, perhaps recognizing teacher test scores as good, uncompensated signals of teacher quality in mainstream schools, more actively recruited individuals with higher test scores.

The results discussed in this section lend support to the idea that charter schools had a realized advantage in the labor market for public school teachers; among licensed teachers changing schools, charters were better able to attract highly experienced teachers, and teachers with high licensure test scores. But a large minority of mainstream teachers moving to charter schools were not fully licensed and attenuated the average qualifications of charter movers. These findings raise the possibility that teachers viewed the charter sector as a low-cost job change preceding retirement or permanent career changes. Sample attrition was high among new teachers, highly experienced teachers, and uncertified teachers, and these are the same groups I observed disproportionately flowing to the charter sector. I find circumstantial evidence that the charter sector was a substitute for or precursor to attrition among inexperienced mainstream teachers. Charter movers with less than four years' experience had a typical post-move duration (uncensored) that was 12.5% shorter than that of inexperienced teachers moving to mainstream schools (2.53 years, versus 2.89). Un-

certified charter movers and those with more than twenty-five years' experience did not leave the panel significantly faster than other mainstream teachers changing schools.

3.2. Classroom Performance of Teachers Moving to Charter Schools

Teachers' on-paper qualifications are readily observable to schools and econometricians, but the performance of their students is of greater value when assessing teacher quality. North Carolina students in the 3rd through 8th grades take end-of-grade (EOG) exams each spring. Each student has an exam proctor, whose name is recorded along with the student's test scores, demographic and socioeconomic information, and survey responses. For test-takers in elementary grades, exam proctors are usually classroom teachers. The Data Center matches proctor names with encrypted teacher identifiers used in other files, and links these identifiers to student test data. I utilized this valuable feature of the data to assess the classroom performance of mainstream grade 3 - 5 teachers who ultimately moved to the charter sector.²⁵ I estimated teacher fixed effects in EOG test score regressions, and then evaluated fixed effect estimates in the same way that I analyzed on-paper qualifications above – by parametrically comparing the fixed effects of charter movers, mainstream movers, and non-movers.

The proctor associated with each student's test score was not necessarily his or her classroom teacher. To minimize the likelihood of invalid teacher-student matches, I focused on teachers with self-contained classrooms of students in grades 3 - 5. Self-contained classrooms embody the traditional structure of elementary education, where a class of students spend all or the majority of each day with one teacher. I assembled grade 3 - 5 student EOG records for more than 2.8 million

²⁵Charter school students are included in the EOG test data; however, more than half of all charter EOG records are missing a teacher/proctor identifier.

student-years spanning 1997 to 2007. A teacher-student match was considered invalid if any of the following four conditions were met. In parentheses are the percent of students for which each condition was true.

1. The student's proctor was unknown or not found in the assembled teacher panel.²⁶ (19.5%)
2. The student's proctor did not have a self-contained classroom assignment. (21.8%)
3. The grade- g student's proctor did not have a teaching assignment with students in grade g . (< 1.0%)
4. The student's exam group was larger than 30 or smaller than 5. (< 1.0%)

The remaining 58.3 percent of students had a proctor who was a teacher, and who led a self-contained classroom with students in the same grade as a reasonable number of EOG test-takers linked to that teacher. These limitations lend considerable validity to each allowed teacher-student match. Of the 122,064 EOG test-taking classrooms with a known teacher, 71.3 percent were considered valid matches. North Carolina's end-of-grade exams are interval-scaled, meaning that a one-point increment reflects the same difference in learning throughout the scale of raw scores. Raw scores are comparable within and across grades each year, and the minimum proficient score rises for each grade. I scaled raw scores to have mean zero and standard deviation equal to one within each year, grade, and school. This calibrated the dependant variable of each education production function to account for variance in the range of raw scores over time, heteroscedasticity in raw scores across grades, and heterogeneity in student performance across schools due to Tiebout (1956) sorting.

²⁶The teacher panel excluded teaching assistants and facilitators, who may have proctored exams.

Consider the following equation describing the standardized test score Z_{ijcgst}^k in subject k (math or reading) for student i in teacher j 's classroom c , grade g , school s , and year t :

$$Z_{ijcgst}^k = \mathbf{A}_{ict}\beta_A + \bar{\mathbf{A}}_{-ict}\beta_{\bar{A}} + \mathbf{T}_{jt}\beta_T + \mathbf{X}_{st}\beta_X + \theta_j + \alpha_{lt} + \varepsilon_{ijcgst} \quad (2)$$

Variables in \mathbf{A}_{ict} are student characteristics, including race, gender, parental education, and learning disability indicators. $\bar{\mathbf{A}}_{-ict}$ is a vector of average student characteristics in i 's classroom (excluding student i), and \mathbf{T}_{jt} controls for two measures of teacher inexperience. \mathbf{X}_{st} contains school-level variables, including quintile indicators for student body size and composition, and a dummy variable equal to one when student i is in a new school. The coefficients θ_j and α_{lt} are teacher fixed effects and county-by-year effects, respectively.²⁷ I estimated Equation 2 and saved estimated teacher fixed effects, $\hat{\theta}_j$. Coefficient estimates for Equation 2 were unsurprising. Female students had lower math but higher reading scores than males. Nonwhite students had lower scores in both subjects, as did students without college-educated parents. Learning disabilities were strongly associated with lower scores, more so for disabilities directly related to the tested subject. Students with inexperienced teachers had lower test scores in both subjects, especially if their teacher was in her first year as opposed to her second or third.

In this setting, teacher fixed effects are interpreted as each individual's history of classroom performance relative to expectations. This should be important to schools looking to hire teachers with a record of success in raising student test scores, but does not necessarily permit the interpretation of $\hat{\theta}_j$ as a transitive index of teachers' inherent quality or value added. The latter view relies on two strong assumptions: (1) $\hat{\theta}_j$ are consistent estimates of θ_j , and (2) errors, ε_{ijcgst} , are

²⁷With controls for teacher inexperience, estimated teacher fixed effects will account for any penalties that are common to all new teachers.

uncorrelated with θ_j . The first assumption is invalid for fixed effect estimates generally, which are inconsistent in short panels Cameron and Trivedi (2005, Ch. 21). Although teacher fixed effect estimates benefit from multiple student-level signals each year, finite class size leads to considerable sampling error. Teacher fixed effect estimates are noisy, and their variance overstates the true variance in teacher quality (Rockoff, 2004). I address this last point in the following subsection by isolating the variance in persistent teacher value added. The second assumption is invalid if there are unmeasured and dynamic student characteristics affecting test scores, like motivation or inherent intelligence, and if these variables systematically affect the teacher to whom a student is assigned. In that case, estimates of θ_j will be a reflection of teacher quality *and* student sorting. Positive matching, such that better students are assigned to better teachers, would bias $\hat{\theta}_j$ away from zero and overstate a teacher's effectiveness or ineffectiveness. Negative matching, which may be the case if better students are assigned to struggling teachers to ease their burden, would bias $\hat{\theta}_j$ toward zero. Clotfelter, Ladd, and Vigdor (2006) found evidence of teacher-student matching, particularly positive matching, in North Carolina schools. The bulk of student sorting was Tiebout (1956) sorting between schools, which I addressed by centering the Equation 2 dependant variable by year, grade, and school.

Nonetheless, Equation 2 fails to control for nonrandom sorting of students within schools, such as would be the case if parents were successfully lobbying school administrators to put their children in particular classrooms.²⁸ Two adaptations to Equation 2 - estimating student gains, or including lagged student test scores - would address likely pathways by which students were non-

²⁸The existence of "teacher shopping" by parents has considerable anecdotal and analytical support. (see, e.g., Hui (2003), Crombie (2001), and Clotfelter et al. (2006))

randomly matched to teachers within schools. Either method would eliminate 3rd grade teachers from the analysis here, an impractical solution given the fairly small number of charter movers for which $\hat{\theta}_j$ can be estimated.²⁹ Furthermore, estimating student gains, even with student fixed effects, is not a fail-safe method for examining teachers' value added (Rothstein, 2008), nor will it circumvent the inherent sampling error of teacher fixed effects. It is important to emphasize that sorting biases would only have affected my analysis to the degree that charter movers were disproportionately subject to non-random within-school student sorting prior to their move. Fixed effects estimated by Equation 2 provide insight to the relative performance of teachers' classrooms – an informative, imperfect, signal of teacher quality.

There were 13,752 mobile teachers for which fixed effects could be estimated, 257 of whom were moving to a charter school. Teacher fixed effects reflect teachers' relative performance within their schools. This limits the scope of interpretation and understates the variance in teacher quality across schools, but adequately addresses between-school sorting. Table 4 summarizes teacher fixed effects estimates. Teachers moving to other mainstream schools had lower fixed effects than non-movers, on average. Charter movers had even lower fixed effects than mainstream movers, by 3.7 percent of a standard deviation in math. For context, the charter-mainstream mover gap in fixed effects represented about 79 percent of the 0.047 standard deviation gap between male and female math performance, as estimated by Equation 2. So charter schools were not skimming the best

²⁹As a robustness check, I estimated Equation 2 with lagged student achievement. This reduced the number of charter movers for whom fixed effects could be estimated, but nonetheless, the finding that charter movers had high math fixed effects, relative to other moving teachers, was robust. Results for reading fixed effects, however, were statistically insignificant.

teachers from mainstream schools, or even above-average teachers.

Simple means do not control for the type of schools teachers were moving to, and charter schools may have attracted relatively high-performing teachers, compared to mainstream schools with similar student populations. I regressed teacher fixed effect estimates against mobility indicators, receiving school characteristics, and receiving county-by-year effects:

$$\hat{\theta}_j^k = \delta_{jt}^m \mathbf{1}(moving) + \delta_{jt}^c \mathbf{1}(tocharter) + \mathbf{X}_{jst(t+1)}^r \theta^r + \alpha_{l(t+1)} + \varepsilon_{jst} \quad (3)$$

Subjects (math and reading) are indexed by k , teachers by j , schools by s , counties by l , and years by t . Table 5 presents estimates of δ_{jt}^m and δ_{jt}^c . Column I lists the estimated difference in fixed effects between mainstream movers and non-movers ($\hat{\delta}_{jt}^m$ in Equation 3). Mobile teachers moving between mainstream schools tended to have lower math and reading fixed effects than non-moving teachers, by 1.8 and 1.4 percent of a student-level standard deviation, respectively. Column II lists the estimated difference in classroom performance between charter and mainstream movers. Charter movers' fixed effects were estimated to be 4.5 percent of a standard deviation higher in math and 4.0 percent higher in reading, relative to those of teachers moving to comparable mainstream schools. Columns III and IV list analogous results for the subsample of regularly licensed teachers. Point estimates for charter and mainstream movers were largely unchanged by excluding unlicensed teachers.³⁰

Class performance is one dimension, along with licensure test scores, where charter schools may have been able to exercise a competitive advantage in the teachers' labor market. North

³⁰Mainstream elementary teachers were predominantly certified, and very few uncertified charter movers could be linked to student test records. This precludes separate analyses of uncertified charter movers' fixed effects.

Carolina’s public education pay scale does not have provisions for merit pay, with the notable exception of \$1,500 bonuses for teachers in schools meeting “exemplary” growth standards. Charters had the allocative freedom to recruit and reward high-performing teachers, budget permitting. Equation 3 coefficients indicate a reverse of the charter-mainstream mover performance gap observed in the descriptive statistics of Table 4. Charter movers did not rank high within the schools they were leaving, but they compared favorably to teachers moving to schools of equivalent size, student proficiency, and racial composition. These findings were in part reconciled by charter movers’ higher propensity to move to schools with lower student achievement. Controlling for sending and receiving school characteristics (answering the question, “were charter movers more effective than teachers *leaving* and *moving to* comparable schools?”) decreased point estimates and statistical significance, but left intact the conclusion that charter movers had higher classroom performance than mainstream movers.

3.3. Variation in Classroom Performance

Teacher fixed effects are excellent indicators of student achievement, but collectively, they yield a poor approximation of the overall distribution of teacher quality. Sampling error from finite panel length and class size cause the variance of teacher fixed effects to overstate the variance of true value added. If sampling error disproportionately affects certain groups of teachers (new teachers, for instance), then the variance of teacher quality distributions would be distorted. This subsection evaluates the quality of teachers from a second-moment perspective and explicitly accounts for the inflating effects of sampling error. Results complement the mean differences in classroom performance discussed in the previous subsection. First, I estimated Equation 2, omitting teacher fixed effects (θ_j).

$$Z_{ijcgst}^k = \mathbf{A}_{ict}\beta_A + \bar{\mathbf{A}}_{-ict}\beta_{\bar{A}} + \mathbf{T}_{jt}\beta_T + \alpha_{it} + e_{ijcgst} \quad (4)$$

Suppressing notation for grade and school, the errors are $e_{ijct} = \theta_j + \varepsilon_{ijct}$. There are two components to each student residual, e_{ijct} : teacher j 's persistent value-added (θ_j), and noise (ε_{ijct}) encompassing sampling error and transient shocks to average classroom performance. The average student residual for each class can be expressed like so:

$$\hat{e}_{jct} = \theta_j + \frac{1}{N_{jct}} \sum_{i=1}^{N_{jct}} \varepsilon_{ijct},$$

where N_{jct} is class size in year t . If θ_j and ε_{jct} are independent, the variance of \hat{e}_{jct} across teachers can be decomposed into the variance of persistent value added and the variance of non-persistent error: $\mathbb{E}[\hat{e}_{jct}^2] = \sigma_\theta^2 + \sigma_\varepsilon^2$, where σ_θ^2 is the variance of persistent teacher quality within schools, and σ_ε^2 is the variance of error within schools. Consider two average residuals from two different classrooms taught by the same teacher: \hat{e}_{jct} and $\hat{e}_{jc't'}$, where $c \neq c'$ and $t \neq t'$. If θ_j and ε_{jct} are uncorrelated, and if the measurement errors, ε_{jct} and $\varepsilon_{jc't'}$, are uncorrelated as well, then

$$\mathbb{E}[\hat{e}_{jct}\hat{e}_{jc't'}] = \sigma_\theta^2.$$

The assumption that θ_j and ε_{jct} are uncorrelated is non-trivial – in fact, it is one of the assumptions that must be met in order to interpret estimated teacher fixed effects as part of a transitive index of teacher quality. Positive matching of better students with better teachers will increase estimates of σ_θ^2 . Additionally, omitting teacher fixed effects in Equation 4 may bias other coefficients if they are correlated with θ_j ; this, in turn, will bias estimated residuals, \hat{e}_{ijct} . Calibrating the dependant variable by school in Equation 4 limits biases from between-school sorting, but within school teacher-student matching patterns may nonetheless affect σ_θ^2 estimates. So long as the correlation between θ_j and ε_{jct} is not systematically different for subsamples of interest, the calculated variance of persistent residuals within groups can be compared. Following Carrell and West (2008), I

estimate σ_{θ}^2 by computing the average covariance of all classroom residual pairs between teacher j 's class c in year t and $c' \neq c$ in year $t' \neq t$:

$$\hat{\sigma}_{\theta}^2 = \left[\sum_{j=1}^J \sum_{c=1}^{C_j} \hat{e}_{jct} \hat{e}_{jc't'} \right] / N \quad (5)$$

J is the number of teachers, C_j is the number of classes taught by teacher j , and N is the number of pairs.

Table 6 presents estimates of total and signal standard deviations.³¹ All standard errors (in parentheses below each standard deviation estimate) were estimated by bootstrap, with an equal number of charter participants and non-participants selected in each sampling. The third and sixth columns of Table 6 list the standard deviation of teacher fixed effects, by group. As expected, estimates of the variation in persistent teacher residuals (signal) were much smaller than the variation in teacher fixed effects (SD(FE)). The latter suggests that a one-standard-deviation increase in teacher quality improved student math performance by 0.237 standard deviations, three times the bonus from having an experienced teacher rather than a new one. But judging by the preferred measure of dispersion, a one-standard-deviation increase in teacher quality would yield a still-substantial 0.179 standard deviation increase in student math performance, closer to the difference between having a college-educated parent versus a parent with “some college.” Estimates of signal variance were somewhat smaller for reading; a one-standard deviation increase in persistent teacher quality was predicted to increase student achievement by 0.137 standard deviations. Signal variation was 48 to 61 percent of total variation, suggesting that differences in teacher qual-

³¹I also estimated σ_{θ}^2 using student, rather than classroom-averaged residuals. Estimates of signal variances were remarkably similar to those shown in Table 6, but estimates of total variance in individual student residuals were 2 - 3 times larger.

ity accounted for much, but not all, of the variation in class performance within schools. Table 6 also lists signal standard deviations separately for future charter teachers and teachers who were never observed in a charter school. The variance of math performance was wider for future charter teachers, but the variance of reading performance was narrower. Both statistics were within two standard errors of the corresponding signal estimate for exclusively mainstream teachers.

Following Kane et al. (2008), I constructed a simple Bayesian shrinkage estimator of persistent teacher quality to account for sampling error in class residuals attributed to teacher quality. I used estimates of signal and noise variance listed in Table 6, along with the number of classes observed for each teacher (C_j) to scale average class residuals (\bar{e}_j):

$$\tilde{\theta}_j = \bar{e}_j \left(\frac{C_j}{C_j + \hat{\sigma}_\varepsilon^2 / \hat{\sigma}_\theta^2} \right) \quad (6)$$

Equation 6 shrinks each teacher's average residual towards zero according to the terms in parentheses. Residuals for teachers with more classes and groups with larger signal-to-noise ratios were scaled by less, since their residuals were expected to be less affected by sampling error.

Figure 3 plots comparative kernel densities of scaled teacher residuals ($\tilde{\theta}_j$), by charter participation. The densities approximate distributions of teacher quality for future charter teachers and exclusively mainstream teachers. There were small but statistically significant differences in quality between the groups. The distributions for future charter teachers were significantly lower than those for exclusively mainstream teachers, particularly for math instruction.³² Figure 3 provides further evidence that teachers flowing to the charter sector typically had low classroom performance relative to their colleagues, but also demonstrates considerable overlap and variation in teacher quality across groups.

³²Wilcoxon rank-sum test statistics (z) were 3.58 and 3.32, respectively, for math and reading.

4. Conclusions and Implications

A founding purpose of North Carolina’s charter legislation was to “create new professional opportunities for teachers.”³³ Implicit in these opportunities is a new dimension of upstream competition in public education. Autonomous charter schools are well-positioned to exploit any inefficiencies in previously monopsonistic markets for public teachers. Mainstream teachers in North Carolina, as in other systems, are paid according to rigid salary schedules that climb steadily with experience and graduate degrees, despite compelling evidence that the returns to experience are largely exhausted after the first few years of a teacher’s career, and that the returns to graduate degrees are insignificant. Charter administrators are free to hire, compensate, and fire according to merit and robust signals of teacher quality. Charters also have the flexibility to structure work environments that are more appealing to teachers, whereas many elements of mainstream employment (especially curricula) are centrally managed. But do charter schools have the resources to exploit these inefficiencies and skim good teachers from the mainstream? Tighter budgets and institutional inexperience may limit the appeal of working in a charter school.

In terms of resume line-items, I find mixed evidence that North Carolina charters were hiring more qualified teachers away from mainstream schools. Teachers moving to charter schools were less experienced on average, and they were less likely to have graduate degrees. But charter schools looking to boost student achievement and minimize payroll may not have valued experience or graduate degrees – two weak indicators of student achievement – as much as other qualifications like licensure test scores. Among regularly licensed teachers, the licensure test scores of charter movers were 0.094 standard deviations higher than those of mainstream movers. Licensure

³³NC Gen. Stat. 115c-238.29a(4) (1996)

test scores are correlated with teacher quality, but the gap in teacher test scores between charter and mainstream movers would have had minimal impact on student achievement. Clotfelter et al. (2007) showed that a one-standard deviation increase in mean licensure test scores resulted in a 0.011 standard deviation increase in students' math achievement levels and a 0.003 standard deviation increase in reading levels. A 0.094 standard deviation test score advantage over mainstream movers, then, translates roughly to a 0.001 standard deviation bonus to math achievement and an infinitesimal bonus to reading achievement.

Charter movers were much less likely than mainstream movers to be regularly licensed, a consequence of relaxed licensure standards for charter schools. North Carolina requires full licensure for just 75 percent of elementary school faculties and 50 percent of middle and high school faculties. Relaxed licensure standards, intended to reduce barriers to teaching, are one piece of the "charter experiment" in North Carolina and elsewhere. But this policy had the consequence of drawing a high rate of uncertified mainstream teachers into the charter sector, some of whom may have been running low on mainstream teaching opportunities. Alternatively or temporarily licensed teachers are not necessarily bad teachers (see, e.g., Boyd et al. (2006) and Kane et al. (2008)), although they have been associated with lower student achievement (Clotfelter et al., 2007), and they certainly attenuated the typical charter mover resume.³⁴ A migration of uncertified teachers into charter schools would not be problematic if charter schools were adept at judging teacher quality,

³⁴In an unreported analysis parallel to Figure 3, I used Equation 6 to approximate teacher quality distributions by type of license. In agreement with Kane et al. (2008), I found small but significant differences in quality between regularly and temporarily licensed teachers, and a wide variance in quality within each group.

regardless of licensure status. The effectiveness of uncertified teachers in charter schools remains an important and unanswered question.

The classroom performance of fully licensed teachers moving to charter schools may be indicative of charters' success in identifying and recruiting effective teachers. I estimated teacher fixed effects for a subset of grade 3 - 5 teachers, and found that charter schools were drawing below-average teachers from school faculties. The discrepancy was not limited to mean differences; the quality distribution for future charter teachers was left of the quality distribution for teachers who never taught in a charter school, visually and statistically. Charter movers compared more favorably, however, to other mobile teachers. Charter schools may not have been winning the best teachers from particular faculties, but among all school-changing teachers, teachers moving to charter schools were more effective math and reading instructors than teachers moving to similar mainstream schools, controlling for the size, proficiency, and racial composition of receiving schools.

Taken together, these findings demonstrate nuanced patterns of teacher quality flowing to charter schools. North Carolina's charter schools were drawing good teachers, particularly among licensed teachers changing schools. But whether because of resource constraints, limited scale, or unobserved costs of working in the charter sector, charter schools were not drawing unambiguously superior teachers from the mainstream *per se*, nor were they skimming the best teachers from mainstream faculties.

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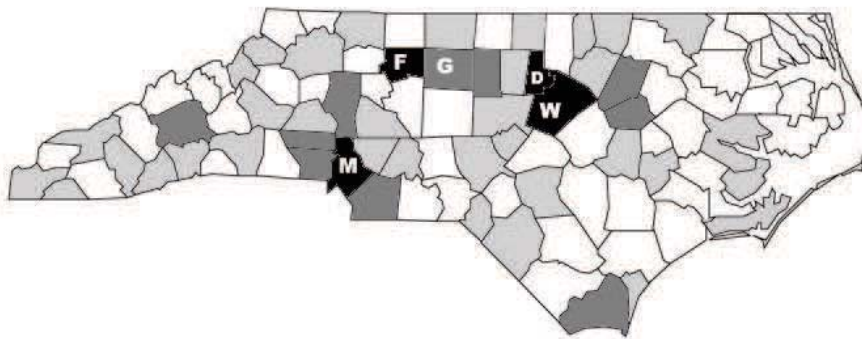
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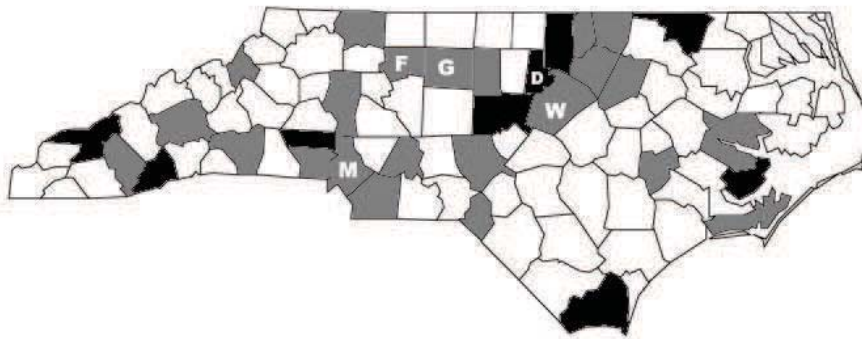
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1 - 500 CHARTER STUDENTS
 501 - 1,500
 1,501 +



2.0 - 5.0 PERCENT IN CHARTER SCHOOLS
 > 5.0 PERCENT

Figure 1: 2006 Charter enrollment and penetration. Major population centers in Cumberland (C), Durham (D), Forsyth (F), Guilford (G), Mecklenburg (M), and Wake (W) counties.

Table 1: In-sample mobility patterns of charter teachers

Teacher Mobility pattern	Percent
Started and ended in the charter system (right censored)	21.5
Started and ended in the charter system (uncensored)	33.6
Mainstream to charter	25.1
Mainstream to charter to mainstream	8.5
Charter to mainstream	10.7
Other patterns	<1.0

Notes: $n = 5,346$ teachers. The first two mobility patterns apply to teachers who taught exclusively in charter schools. Right censored charter teachers entered the sample in the charter system and were still teaching there in 2007, the last year of the panel. Uncensored teaching spells ended before 2007. The last four mobility patterns apply to teachers who taught in charter and mainstream schools. The percent of all charter participants who followed each pattern is indicated at right.

Table 2: North Carolina public school teachers: Summary statistics

	All teachers	All movers	Mainstream movers	Charter movers
Teacher qualification				
Holds graduate degree (%)	30.8 (46.2)	27.5 (44.6)	27.5 (44.7)	25.2 (43.4)
Attended competitive college (%)	76.2 (42.6)	75.0 (43.3)	75.1 (43.3)	70.6 (45.6)
Mean licensure test score	0.030 (0.857)	0.015 (0.839)	0.015 (0.838)	0.029 (0.905)
Regularly licensed (%)	89.5 (30.7)	88.8 (31.6)	89.0 (31.3)	79.1 (40.7)
Teaching experience (years)	11.93 (9.92)	8.89 (8.72)	8.92 (8.71)	7.45 (8.97)
Experience ≤ 3 years (%)	26.1 (43.9)	36.3 (48.1)	36.1 (48.0)	47.5 (50.0)
Experience ≥ 25 years (%)	14.5 (35.2)	7.5 (26.3)	7.5 (26.3)	8.9 (28.5)
Nonwhite (%)	16.9 (37.4)	18.1 (38.5)	17.9 (38.3)	26.4 (44.1)
Female (%)	79.8 (40.1)	79.8 (40.2)	79.8 (40.2)	79.2 (40.6)
n (teacher-years)	886,343	58,629	57,487	1,142

Notes: Standard deviations appear in parentheses below each mean. Data for moving teachers are evaluated in the year immediately preceding a school change.

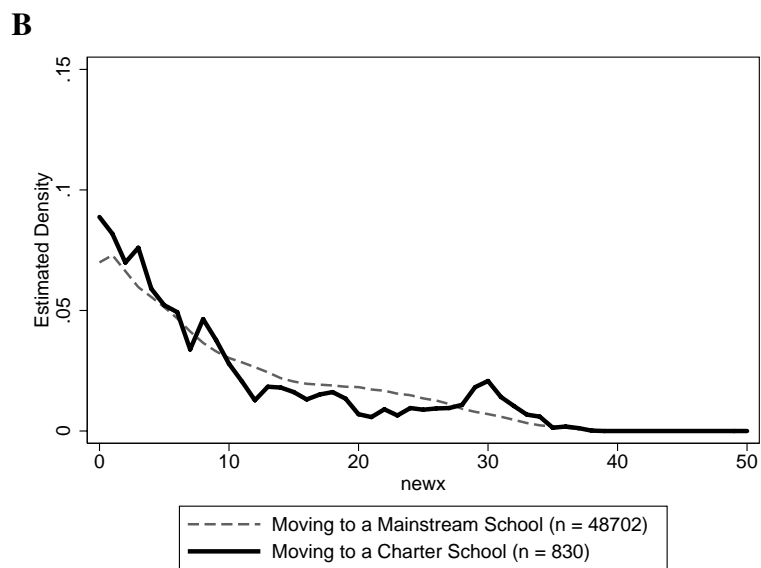
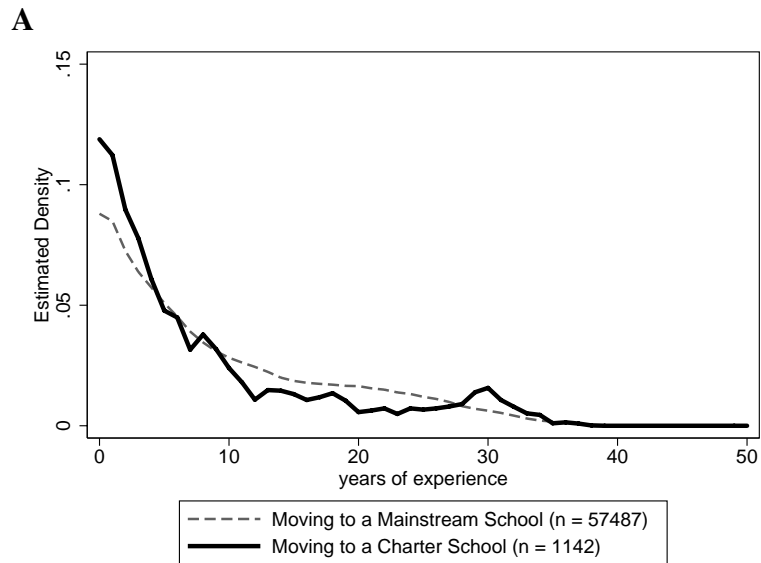


Figure 2: Density estimates: Years' experience of all mobile teachers (A) and of licensed mobile teachers (B). Densities were estimated using Epanechnikov kernel functions and halfwidths of 0.50 years.

Table 3: Regression results: Qualifications of teachers changing schools, by licensure and charter/mainstream destination

	I	II	III	IV
Sample	All	All	Licensed	Licensed
Destination	Mainstream	Charter	Mainstream	Charter
(Equation 1 coefficient)	$(\hat{\delta}_{jt}^m)$	$(\hat{\delta}_{jt}^c)$	$(\hat{\delta}_{jt}^m)$	$(\hat{\delta}_{jt}^c)$
Graduate degree	0.003 (1.41)	-0.027 (2.03)	0.007 (3.06)	-0.028 (1.70)
Competitive college	-0.011 (5.63)	-0.016 (1.20)	-0.006 (2.88)	0.003 (0.21)
Licensed	-0.012 (8.53)	-0.074 (6.15)		
Mean licensure test score	-0.027 (7.00)	0.019 (0.68)	-0.023 (5.77)	0.094 (3.33)
Experience (years)	-3.69 (81.75)	-1.07 (3.52)	-3.66 (76.29)	-0.44 (1.21)
Experience ≤ 3 years	0.132 (58.29)	0.070 (4.58)	0.120 (51.97)	0.049 (2.90)
Experience ≥ 25 years	-0.102 (65.22)	0.070 (5.86)	-0.100 (60.91)	0.059 (4.37)

Notes: $n = 886,343$ teacher-years. Column I lists the estimated difference in qualification k between teachers moving to mainstream schools and non-movers ($\hat{\delta}_{jt}^m$ in Equation 1). Cells in column II list the estimated difference in k between charter and mainstream movers ($\hat{\delta}_{jt}^c$). Columns III and IV present these same coefficients for the subsample of regularly licensed teachers. Control variables included receiving school characteristics (student racial composition, performance composite, school size, school age, grade ranges served), a set of dummy variables for missing data, and county-by-year effects. The absolute values of t -statistics are reported in parentheses below each coefficient. Robust standard errors were clustered within each school and year.

Table 4: North Carolina public school teacher fixed effects: Summary statistics

	All teachers	All movers	Mainstream movers	Charter movers
Fixed effect estimates				
Math	-0.016 (0.258)	-0.036 (0.262)	-0.035 (0.263)	-0.072 (0.253)
Reading	-0.013 (0.225)	-0.029 (0.227)	-0.028 (0.227)	-0.057 (0.242)
n (teacher-years)	167,244	13,752	13,495	257

Notes: Cells represent average fixed effect estimates, by subject and mobility status. Standard deviations appear in parentheses below each mean. Data for moving teachers were evaluated in the year immediately preceding a school change.

Table 5: Regression results: Classroom performance of teachers changing schools

	I	II	III	IV
Sample	All	All	Licensed	Licensed
Destination	Mainstream	Charter	Mainstream	Charter
(Equation 3 coefficient)	$(\hat{\delta}_{jt}^m)$	$(\hat{\delta}_{jt}^c)$	$(\hat{\delta}_{jt}^m)$	$(\hat{\delta}_{jt}^c)$
Math	-0.018 (7.20)	0.045 (2.64)	-0.017 (6.76)	0.044 (2.35)
Reading	-0.014 (6.79)	0.040 (2.41)	-0.014 (6.36)	0.044 (2.43)

Notes: $n = 167,244$ teacher-years. Column I lists the estimated difference in fixed effects between mainstream movers and non-movers ($\hat{\delta}_{jt}^m$ in Equation 2). Column II lists the estimated difference in fixed effects between charter and mainstream movers ($\hat{\delta}_{jt}^c$). Columns III and IV present these same coefficients for the subsample of regularly licensed teachers. Unreported control variables include receiving school characteristics (student racial composition, performance composite, school size, school age, grade ranges served), a set of dummy variables for missing data, and county-by-year effects. The absolute values of t -statistics are reported in parentheses below each coefficient. Robust standard errors were clustered within each school and year.

Table 6: Variation in teacher quality

Subject	Math	Math	Math	Reading	Reading	Reading
Measure of variance	Total	Signal	SD(FE)	Total	Signal	SD(FE)
All teachers	0.291 (0.009)	0.179 (0.017)	0.237 (0.013)	0.263 (0.008)	0.137 (0.015)	0.205 (0.012)
Never a charter teacher	0.294 (0.011)	0.156 (0.019)	0.236 (0.018)	0.260 (0.008)	0.136 (0.016)	0.205 (0.011)
Future charter teacher	0.307 (0.009)	0.183 (0.015)	0.255 (0.008)	0.276 (0.008)	0.132 (0.014)	0.232 (0.009)

Notes: $n = 167,244$ teacher-years. Student math and reading scores were regressed against student characteristics, teacher experience indicators, peer characteristics, and school-by-year effects (Equation 4). “Total” is the standard deviation of student residuals from Equation 4 estimates. “Signal,” calculated by Equation 5, is the standard deviation of teachers’ persistent value-added, by group. “SD(FE)” is the standard deviation of teacher fixed effects, estimated by Equation 2. Standard errors, in parentheses below each standard deviation estimate, were estimated by bootstrap with an equal number of charter participants and non-participants selected in each sampling.

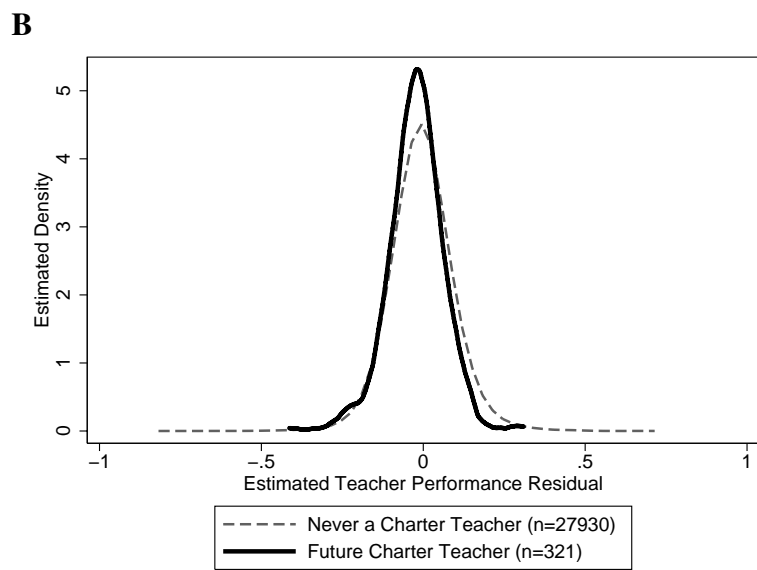
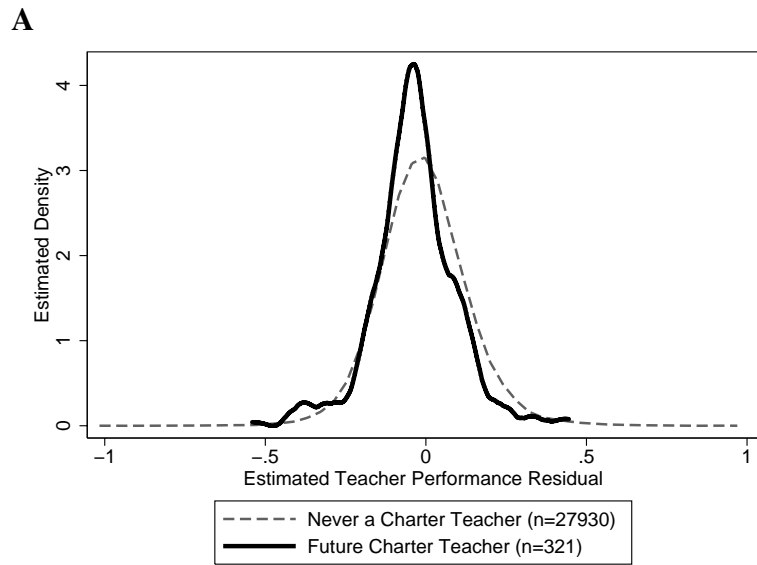


Figure 3: Density estimates: Persistent teacher quality in math (A) and reading (B) for future charter teachers and exclusively mainstream teachers. Densities were estimated using Epanechnikov kernel functions and halfwidths of 0.025 scaled standard deviations.