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*The Qualifications  
and Classroom  
Performance of  
Teachers Moving to  
Charter Schools*

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## The Qualifications and Classroom Performance of Teachers Moving to Charter Schools

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Celeste K. Carruthers  
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## **Abstract**

Do charter schools draw good teachers from traditional, mainstream public schools? Using a panel dataset of all North Carolina public school teachers from 1997-2007, this research paper finds 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. Estimated measures of classroom performance for a subset of grade 3 - 5 teachers 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. The distribution of classroom performance among future charter teachers, adjusted for sampling error, was significantly lower than the distribution for exclusively mainstream teachers.

# I. Introduction

Charter schools are independently operated public schools, free from most 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. Charter systems are designed to provide families with more choice in their children's education, to provide teachers with more choice in their career paths, to promote innovative instruction, and to target special populations of students that may be under-served by traditional public 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 1998-2007.<sup>1</sup>

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 the

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

jury is still out as to whether they actually increase student learning relative to mainstream schools. The emerging consensus is that new charters have a negative impact on student achievement growth, a penalty which fades as schools and students gain experience.<sup>2</sup>

Teacher quality is a profound factor in student achievement,<sup>3</sup> 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, 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.<sup>4</sup>

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 more comparable to mainstream salaries,<sup>5</sup> but charter teachers in some states 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, manipulating class size and composition, and granting teachers

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

<sup>3</sup>Goldhaber (2008) provides a thorough review of research on teacher credentials and their effect on student achievement.

<sup>4</sup>Findings 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, and Rivkin (2004), Falch and Strøm (2005), and Scafidi, Sjoquist, and Stinebrickner (2007).

<sup>5</sup>Nationally, 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.

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 (Budde (1988); Kolderie (1990)). High teacher satisfaction rates in charter schools typically stemmed from greater autonomy (“freedom to teach the way I want”), like-minded colleagues, and innovative teaching philosophies. Teachers who were dissatisfied in charter schools cited low pay, lack of benefits, high workload, and insufficient facilities (Malloy and Wohlstetter, 2003).

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 char-

ter 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 teachers realized a 7.5 percent pay cut upon moving to a charter school.

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 have recorded 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, allowing me to estimate measures of instructional effectiveness. 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.

In this study, 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 also evaluate their classroom performance directly, using estimated teacher fixed effects on student end-of-grade math and reading exam scores. Charter movers were low in sending school distributions of classroom performance, relative to their colleagues, but compared favorably to mainstream teachers moving to similar 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 a significantly lower figure.

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 teachers more effective than teachers moving to comparable mainstream schools, but low licensure requirements attracted uncertified, less qualified teachers who may have had few career options in the mainstream sector. The paper is organized as follows. Section II reviews pertinent details of the North Carolina charter system and describes the data. Section III outlines the analytic methodology and discusses results. Section IV concludes.

## **II. Charter Schools in North Carolina**

### **A. Background**

North Carolina is an ideal setting to study teacher mobility into charter schools. The state's charter system is eleven years old, its schools are spread throughout urban, rural, and socioe-

conomically diverse regions of the state, and extensive data (described fully in section IIB) 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. The largest drawback of researching North Carolina's charter system is its scale: the state has a 100-school cap,<sup>6</sup> and accordingly, a very small percent of teachers move to charter schools in a given year. The comparison group – mainstream teachers moving to other mainstream schools – is large and varied, as are the schools they move 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. There are several stated objectives of the system, including increased learning opportunities for students and new professional opportunities for teachers.<sup>7</sup> The state's first thirty-four charter schools opened for the 1998 school year. Table 1 documents the growth of North Carolina's charter system from that year up to 2007.<sup>8</sup> Charter students accounted for 2.0 percent of statewide enrollment by 2007, and charter teachers accounted for 2.1 percent of public school teachers. 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

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<sup>6</sup>The cap has been binding since 2001, although not all approved charters are active in a given year. Even with the cap, the charter system will continue to grow as schools add grades and campuses.

<sup>7</sup>North Carolina General Statute 115c-238.29a

<sup>8</sup>Some charter schools appear to be missing from the 2007 data.

of the major population centers.<sup>9</sup>

The application, approval, and evaluation of charter schools is closely regulated, but the schools are given wide latitude in their personnel management and daily operations. Charter schools are organized as private, nonprofit organizations.<sup>10</sup> 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.<sup>11</sup> 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.<sup>12</sup>

A distinctive feature of North Carolina's charter school system is a pronounced racial segregation.<sup>13</sup> Just over half of the state's charter schools had racially imbalanced student populations, meaning that the percent of students who are nonwhite was twenty percentage points above or below the county-wide nonwhite representation. By comparison, just one-quarter of mainstream schools were racially imbalanced. Charter schools are required to "reasonably reflect the racial and ethnic composition of the general population"<sup>14</sup> residing in the school district (which, for most schools, is a county district). Exception is given to schools serving a targeted population, 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.

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<sup>9</sup>The State Board of Education limits annual charter growth within any one district.

<sup>10</sup>The nonprofit requirement does not preclude for-profit education management organizations like KIPP from granting franchises in North Carolina.

<sup>11</sup>State 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)

<sup>12</sup><http://www.wral.com/asset/news/local/2007/11/14/2045129/ClosedCharterSchools.swf>

<sup>13</sup>Bifulco and Ladd (2006) fully explored the segregating effects of North Carolina's charter program.

<sup>14</sup>NC Gen. Stat. 115C-238.29F(g)(5) (1996)

Charter schools are held to the same accountability model as mainstream public schools, with some exceptions for charters in their first year. Each year, North Carolina schools are awarded recognition labels according to their students' performance and growth on end-of-grade and end-of-course exams.<sup>15</sup> In 2006, 53 percent of charter schools were given one of the lowest three recognition labels, compared to 48.1 percent of public schools statewide (Manuel, 2007). But charters were well-represented at both extremes of the performance composite distribution. In 2006, charters were 2.6 times as likely as mainstream schools to have performance composites lower than 50,<sup>16</sup> 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 moving to charter schools. Each school's profile will affect 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 certificates. This number falls to 50 percent for charter teachers of grades six through twelve.<sup>17</sup> 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

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<sup>15</sup>"School of Excellence," "School of Distinction," and "Low-Performing School" were three of the seven 2006 labels. A school's recognition is based on the percent of students who performed at grade level on year-end exams (the schools' performance composite), whether or not the school met state-mandated growth expectations, and whether or not students made "adequate yearly progress," a metric related to the federal No Child Left Behind Act. Schools are then charged with the coming year's growth expectations, which will in part determine the coming year's recognition. (North Carolina State Board of Education, 2006, HSP-C Series)

<sup>16</sup>Schools with sub-50 performance composites that fail to make expected growth benchmarks are given "Low-Performing" recognition. Schools with repeat low-performing status, including charter schools, 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)

<sup>17</sup>Uncertified charter teachers are supposed to meet the federal definition of "Highly Qualified." Although this requirement does not appear to be strictly enforced, uncertified teachers can meet the standard by majoring or passing a Praxis II exam in their subject area.

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 there is little difference between the quality distributions of certified, alternatively certified, or even uncertified teachers.<sup>18</sup> 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. ([Center For Education Reform, 2008](#))

## **B. Data**

I use data covering the universe of North Carolina public schools, students, and teachers over the years 1997 to 2007. The data are maintained by the North Carolina Education Research Data Center at Duke University, in collaboration with the state Department of Public Instruction.<sup>19</sup> School-level variables include yearly performance composites, school size, and student demographic statistics from the NCES Common Core. For teachers and students, the Data Center processes a vast amount of detailed, passively collected administrative data. Each public school teacher and student is assigned a unique, anonymous identifier, allowing researchers to build longitudinal panels and track teachers and students across schools.<sup>20</sup> I collected teachers' demographic information and school assignments from student activity reports. These reports are detailed records of every activity involving students and public school personnel, including charter school personnel. Unfortunately, this is nearly the extent of data available for charter school teachers. Nonetheless, the North Carolina data provide a rare,

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<sup>18</sup>We 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.

<sup>19</sup>See [Muschkin, Bonneau, and Dodge \(2008\)](#).

<sup>20</sup>Teachers who return to public schools following an absence retain their old identifier.

comprehensive picture of the flow of labor between mainstream and charter schools. For mainstream teachers, I collected additional information from personnel files: experience, education, type of licensure, and licensure test scores. I merged data from school activity reports and several personnel files to produce a longitudinal panel of public school teachers spanning the years 1997-2007. School-wide statistics (grades served, school age, and quintile indicators for student body demographics and proficiency) were merged with the teacher panel to provide a robust statistical picture of teachers' work environments and career paths.

Two features of North Carolina public school data are especially valuable for this study. First, I can track teachers as they change schools. This allows me to 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 utilized 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 2 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, 55.1 percent, were never observed teaching outside of the charter sector. Another 33.6 percent taught in a mainstream public school before moving to a charter. Of these, two-thirds moved directly to a charter school, without leaving the panel between schools. The remaining third taught in a mainstream school, left the panel for one or more years, and then re-entered in a charter school. I focus on direct movers, who were continuously employed over their transition to the charter sector. I compare the qualifications of direct charter movers to the qualifications of other teachers making direct moves between mainstream schools.<sup>21</sup> By evaluating charter movers against other mobile teachers (as opposed to public school teachers

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<sup>21</sup>Seventy-eight percent of mainstream movers did not leave the panel between schools. The results to follow in sections IIIA and IIIB are qualitatively similar, but with varying statistical precision, if I adopt more liberal definitions of teacher mobility. The section IIIC analysis approximates the distribution of persistent teacher quality among all pre-charter teachers, whether or not they took breaks between schools.

more generally), I avoid selection biases from omitted variables contributing to mobility *per se*, and I can judge what sort of talent charter schools were drawing from the pool of teachers willing to change schools. After controlling for receiving school characteristics, I determine if charter schools were recruiting more or less of each specific teacher characteristic than their mainstream counterparts. 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.

### III. Analytic Methods and Results

#### A. The Qualifications of Teachers Moving to Charter Schools

Table 3 lists summary statistics for North Carolina’s mainstream public school teachers from 1997 to 2007. Teachers were identified as school personnel with teaching assignments in school activity reports, excluding teaching assistants, facilitators, and DARE officers. 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*.<sup>22</sup> 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.<sup>23</sup> Regularly licensed teachers had completed an approved teacher education program and passed the Praxis Series of exams, or attained licensing by reciprocal or interstate agreement. The complements to regularly licensed teachers were uncertified teachers holding temporary, emergency, or provi-

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<sup>22</sup>The 1995 edition roughly corresponds with the graduation date of mobile teachers with six years (the median) of experience.

<sup>23</sup>Although exams were scaled to have mean zero, teacher test scores were positive on average (0.030). This is probably reflective of selective survival and longevity among active teachers. That is to say, teachers with higher exam scores stayed in the panel longer.

sional licenses.<sup>24</sup> Teaching experience was derived from teachers' pay level code, or if that was missing, imputed empirically where reasonable. Teachers' race, gender, and school assignment were determined from school activity reports. Teachers assigned to multiple schools in any one school year were not included in the panel.<sup>25</sup>

Mobile teachers, summarized in the second column of Table 3, were earlier in their careers, on average, and less likely to have a graduate degree than teachers who were not changing schools.<sup>26</sup> 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 3, were typically less qualified than other moving teachers. Teachers transitioning to the charter system 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.<sup>27</sup> 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, twice the rate of uncertified teachers moving to another mainstream school. Charter movers were less experienced as well, by 1.27 years on average, and they were 7.9 percentage points more likely to have three or fewer years of teaching experience. Interestingly, charter movers were also more likely to have *at least* twenty-five years of experience. The rate of nonwhite teachers was much higher among charter movers (26.4 percent) than among mainstream movers.

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<sup>24</sup>In 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 eliminates every alternative licensure path, including lateral entry. 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.

<sup>25</sup>This affected a non-trivial percent of teacher-year observations (6.1), including teachers with roving assignments and teachers who switched schools mid-year.

<sup>26</sup>A mobile teacher is defined throughout as one observed in school  $a$  in year  $t$  and school  $a' \neq a$  in year  $t + 1$ .

<sup>27</sup>Charter movers were also more likely than mainstream movers to have missing license data (8.1 versus 4.8 percent) The main results are unaffected if I classify these individuals as unlicensed. A more problematic data quality issue is the high rate of missing licensure test scores among charter movers (11.8 versus 7.8 percent for mainstream movers). Below, I discuss where this could affect results and the sensitivity tests I used to evaluate potential biases.

Figure 2 illustrates comparative kernel densities for the teaching experience of mobile teachers, by charter/mainstream destination. Clearly, 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. The distribution of charter movers' licensure test scores in Figure 3 also hints at a noisy bimodality, but more importantly, the distribution of *licensed* charter movers' licensure scores (lower panel) appears to be to the right of mainstream movers' distribution. Charter movers, particularly those with regular licensure, were somewhat more likely than their mainstream counterparts to have high licensure test scores, 0.5 - 2.0 standard deviations above the mean. The visual difference is not entirely due to noise. Wilcoxon rank-sum tests indicate that score distributions were not significantly different between charter and mainstream movers overall, but that licensed charter movers' scores were significantly greater than those of licensed mainstream movers.

The nonparametric evaluation of charter movers' qualifications, together with the fully parametric analyses to follow, provide a rich, descriptive picture of the value that teachers took with them when they moved to the charter sector. But this picture is incomplete without an understanding of the schools these teachers were moving between. 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.

Figures 2 and 3 offer visual depictions of the range of experience and achievement that teachers brought with them when they moved to the charter system, but comparative kernel densities 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  $l$ :

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

Equation (1) is a reduced form expression for qualification  $k$ , where  $k$  indexes the on-paper qualifications summarized in Table 3: graduate degree, competitive college education, mean licensure test score, regular licensure, and three measures of experience.<sup>28</sup> 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. Coefficients  $\hat{\delta}_{jt}^m$  are the estimated difference in  $k$  between mainstream movers and non-movers. The coefficient of interest,  $\hat{\delta}_{jt}^c$ , estimate the difference in qualification  $k$  between 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 ( $\alpha_{l(t+1)}$ ).<sup>29</sup> If charter schools had higher demand for some qualifications, and were able to outbid comparable mainstream schools by manipulating employment terms and working conditions, then  $\hat{\delta}_{jt}^c$  would be positive. If instead  $\hat{\delta}_{jt}^m$  was insignificant or negative, then charters had lower demand, or were unable to realize an advantage

<sup>28</sup>Equation (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, non-causal 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.

<sup>29</sup>Results were qualitatively similar when I controlled for sending and receiving school characteristics. Specifications with receiving school characteristics alone are preferred, as they better describe the relative flow of teacher qualifications to charter and mainstream schools of comparable size and student composition.

in the teachers’ labor market. 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. These variables controlled for school environments that affected the type of candidates drawn to a particular school. 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.

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 represent fundamentally different sections of the labor market, I limited equation (1) to regularly licensed movers and produced separate “licensed mover” estimates of  $\delta_{jt}^m$  and  $\delta_{jt}^c$  for all qualifications except licensure itself.

Table 4 lists estimates of  $\delta_{jt}^c$  and  $\delta_{jt}^m$  for each resume qualification.<sup>30</sup> The first column of Table 4 lists coefficient estimates for  $\delta_{jt}^m$ , the typical difference in qualification  $k$  between teachers moving to mainstream schools and non-moving teachers, controlling for receiving school characteristics. Estimates of  $\delta_{jt}^m$  serve as the baseline to which  $\delta_{jt}^c$  estimates are compared. Movers were significantly different than non-movers with respect to most qualifications, but with the exception of experience, the estimated gap was small. 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.

<sup>30</sup>Unreported coefficients for school variables and teacher experience were largely unsurprising. Relative to schools in the top quintile of grade-level performance, teachers from schools in lower quintiles were successively less likely to hold a graduate degree, a competitive college pedigree, or regular licensure. They were less experienced, and had lower licensure test scores. The same can be said for teacher qualifications in 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.

The second column of Table 4 presents estimates of  $\delta_{jt}^c$  from equation (1). Column II coefficients 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, relative to mainstream movers, and 7.4 percentage points less likely to be licensed. Since mainstream movers were themselves less likely to be licensed, relative to non-movers, the coefficient estimates from the licensure and experience equations 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, and less experienced than non-moving teachers by 4.76 years. Despite low average years of experience, charter movers were *more* likely than other moving teachers to have at least twenty-five years’ experience. This is in agreement with the bimodal pattern of experience seen in Figure 2.

Column I and II results were generated from analyses of all public school teachers, regardless of their licensure status. Fully licensed teachers may have had more options in the mainstream sector than unlicensed, untenured teachers. Accordingly, licensed teachers’ mobility decisions better represent 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. The difference between the full and limited sample is particularly stark for licensure test scores. The coefficient for licensed charter movers in

the test score equation is positive and significant.<sup>31</sup> Teachers moving to charter schools typically had higher test scores than their licensed colleagues, whether or not those colleagues were changing schools. Licensed teachers moving to a charter school had an average test score 9.4 hundredths of a standard deviation higher than that of mainstream movers. By comparison, licensed mainstream movers had lower test scores than non-movers, by 2.3 percent of a standard deviation.

It is sensible that charter schools would have been able to attract teachers with higher licensure test scores. Conditional on licensure itself, test scores are not rewarded in the state's pay scale. Yet a teacher's test scores are good indicators of how well his or her students will do on their own tests. Goldhaber (2007) and Clotfelter, Ladd, and Vigdor (2007) have shown that North Carolina teachers with higher licensure test scores were associated with higher student achievement on end-of-grade math and reading exams. Charter schools, perhaps recognizing teacher test scores as good signals of teacher quality, had more success recruiting individuals with higher test scores than comparable mainstream schools.

These findings raise the possibility that teachers viewed the charter sector as a low-cost job change preceding retirement or a permanent career change. Sample attrition was high among new teachers, experienced teachers nearing retirement, and uncertified teachers,<sup>32</sup> and these are the same groups I observed disproportionately flowing into the charter sector. Following a school change, charter movers with three or fewer years' experience stayed in the sample

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<sup>31</sup>The estimated difference in charter and mainstream movers' mean licensure test scores could be attributed to selection bias. Charter 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). Licensure test scores proxy for each teacher's underlying knowledge. If teachers with missing test score data came from lower in the underlying distribution, then the average observed test score of all teachers would be biased upwards from the true average of underlying knowledge. If charter movers with missing test data came from much lower in the underlying distribution than mainstream movers with missing data, the estimated difference between charter and mainstream movers' test scores would be biased in favor of the charter movers. I simulate situations like this using the Table 4, column III specification to gage the sensitivity of charter movers' test score advantage to various counterfactual scores for teachers with missing data. 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. More than a 2.0 standard deviation gap was necessary to produced the result that licensed charter movers had significantly lower test scores than mainstream movers.

<sup>32</sup>There were 89,311 uncensored sample exits in the North Carolina teachers' panel. Of these, 28.8 percent had three or fewer years' experience, 37.7 percent had at least twenty-five, and 30.6 percent were uncertified or had missing license data.

an average of 2.53 years (uncensored), compared to 2.89 years for mainstream movers. The difference was statistically significant, but represented just a 10% gap in duration post-move. The post-move duration of uncertified charter movers and those with more than twenty-five years' experience was not statistically different from the average post-move duration of the equivalent groups of mainstream movers. So the charter sector does not appear to have been a strong substitute for attrition among unlicensed or highly experienced teachers, but inexperienced charter movers did tend to leave North Carolina public schools somewhat faster than other teachers changing schools.

The results discussed in this section lend some 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.<sup>33</sup> But a large minority of mainstream teachers moving to charter schools were not fully licensed and attenuated the average qualifications of charter movers. This was likely a consequence of the state's low licensure requirements for charter schools. What remains to be seen is if the migration of uncertified teachers to the charter sector was predominantly driven by the charters' demand for low-cost labor, or by uncertified teachers' willingness to supply it.

Some resume line-items like licensure test scores are robust signals of teacher quality, and charter schools were effectively competing for licensed teachers with relatively high test scores. But were charter schools drawing teachers with histories, and not just signals, of actual classroom effectiveness? In the following section, I evaluate the classroom performance of charter movers who could be reliably matched to the students they taught.

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<sup>33</sup>These results were not driven by the 8.5 percent of charter teachers who moved from the mainstream to charter sector, and then back to the mainstream. Excluding this group from the above analyses reinforced results, particularly with respect to licensure test scores.

## **B. The 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 (typically 3 - 5 in North Carolina), exam proctors are usually classroom teachers. The Data Center matches proctor names with encrypted teacher identifiers used in other files, and then links these identifiers to student test data. I utilize this valuable feature of the data to assess the classroom performance of mainstream grade 3 - 5 teachers who ultimately moved to the charter sector.<sup>34</sup> I estimate teacher fixed effect coefficients in EOG test score regressions, and then evaluate 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 bad 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 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.<sup>35</sup> (19.5%)
2. The student's proctor did not have a self-contained classroom assignment. (21.8%)

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<sup>34</sup>Charter school students are included in the EOG test data; however, more than half of all charter EOG records are missing a teacher/proctor identifier.

<sup>35</sup>The teacher panel excluded teaching assistants and facilitators, who may have proctored exams.

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.<sup>36</sup> 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 anywhere on the scale of raw scores. 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 distributional shifts in student performance across schools due to [Tiebout \(1956\)](#) sorting.

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  $t$ :

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

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  $\mathbf{T}_{jct}$  controls for two measures of teacher inexperience.  $\mathbf{X}_{slt}$  contains school-level variables, including quintile indicators for student body size and composition, grade levels, and a dummy variable equal to one when student  $i$  is in a new school.

<sup>36</sup>Restricting the sample to self-contained classrooms, while necessary to ensure valid teacher-student matches, probably resulted in a non-representative subset of classrooms. Scaled scores from self-contained classrooms were significantly lower than scores from other classrooms. The mechanism behind this gap is unclear; one possibility is that higher-quality districts and schools were more likely to adopt modern, departmentalized classroom structures. This would be problematic for the current study if the gap between performance in self-contained and departmentalized classrooms was systematically different for future charter teachers, but I did not find this to be the case.

The coefficients  $\theta_j$  and  $\alpha_{it}$  are teacher fixed effects and county-by-year effects, respectively.<sup>37</sup> 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. The penalty from teacher inexperience fell about 80 percent following a teacher's first year.

In this setting, teacher fixed effects are interpreted as each individual's history of classroom performance relative to expectations, given the composition of her students, intraschool sorting, and the teacher's own experience. 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  $\theta_j$ , and (2) errors,  $\varepsilon_{ijcgst}$ , are uncorrelated with  $\theta_j$ . The first assumption is invalid for fixed effect estimates generally, which are inconsistent in short panels (Cameron and Trivedi, 2005). 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 in the following subsection by isolating the variance in persistent teacher value added. The second assumption is invalid if there are unmeasured student variables 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  $\theta_j$  will be a reflection of teacher quality *and* student sorting. Positive matching, such that better students were assigned to better teachers,

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<sup>37</sup>With controls for teacher inexperience, estimated teacher fixed effects will account for any penalties that are common to all new 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 were 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.<sup>38</sup> Two adaptations to equation (2) - estimating student gains, or including lagged student test scores - would address likely pathways by which students were non-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.<sup>39</sup> 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 the analysis to the degree that charter movers were disproportionately subject to non-random within-school student sorting prior to their move. Estimated teacher fixed effects provide insight to the relative performance of teachers' classrooms, which would be of interest to potential receiving schools.

I estimated more than 28,000 teacher fixed effects for both subjects. There were 13,752 mobile teachers in the sample, 257 of which 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

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<sup>38</sup>The existence of "teacher shopping" by parents has considerable anecdotal and analytical support. (Hui (2003); Crombie (2001); Clotfelter et al. (2006))

<sup>39</sup>As 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 relatively high within-school math fixed effects was robust. Results for reading fixed effects, however, were statistically insignificant.

between-school Tiebout (1956) sorting.<sup>40</sup> Table 5 summarizes teacher fixed effects estimates. Teachers moving to other mainstream schools had significantly lower fixed effects than non-moving teachers, by 1.9 (1.5) percent of a standard deviation in math (reading). 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 78.5 percent of the 0.047 standard deviation gap between male and female math performance, as estimated by equation (2). So charter schools were not drawing mainstream schools' best teachers, as measured by teacher fixed effects.

Summary statistics from Table 5 indicate that teachers who moved to charter schools were relatively low in the distribution of teacher quality within their sending mainstream schools. But these 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 the flow of labor going to comparable mainstream schools. I regressed teacher fixed effect estimates against mobility indicators, receiving school characteristics, and receiving county-by-year effects:

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

Subjects (math and reading) are indexed by  $k$ , teachers by  $j$ , schools by  $s$ , counties by  $l$ , and years by  $t$ . Table 6 presents estimates of  $\delta_{jt}^m$  and  $\delta_{jt}^c$ . 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, albeit mainstream schools. Equation (3) coefficients indicate a reverse of

<sup>40</sup>Average fixed effects were 24 - 38 percent larger in absolute value students' raw scores were calibrated to mean statewide performance rather than mean school-wide performance.

the charter-mainstream mover performance gap observed in the descriptive statistics of Table 5. 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.<sup>41</sup>

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 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. I find that charter schools were not drawing relatively high-performing teachers, when measured against their sending school colleagues. But teachers who moved to the charter sector were more effective than teachers moving to comparable schools, in terms of size, student proficiency, and racial composition. These findings were not reconciled by charter movers' lower propensity to "trade up" to a school with higher student proficiency. 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.

### **C. Variation in Classroom Performance**

Teacher fixed effects are strong predictors 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 and transitivity of teacher quality distributions would be distorted. This subsection evaluates the quality of teachers from a second-moment

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<sup>41</sup>The rate of regular licensure was much higher among elementary-grade teachers.

perspective and explicitly accounts for the inflating effects of sampling error. I compute the variance in persistent teacher quality across all teachers, then separately for future charter teachers and exclusively mainstream teachers. Results complement the mean differences in classroom performance discussed in the previous subsection. First, I estimated equation (2), omitting teacher fixed effects ( $\theta_j$ ).

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

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

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

The assumption that  $\theta_j$  and  $\varepsilon_{jct}$  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  $\sigma_\theta^2$ . Additionally, omitting teacher fixed effects in equation (4) may bias other coefficients if they are correlated with  $\theta_j$ ; 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  $\sigma_\theta^2$

estimates. So long as the correlation between  $\theta_j$  and  $\varepsilon_{jct}$  is not systematically different for subsamples of interest (uncertified teachers or charter participants), the calculated variance of persistent residuals within groups can be compared. Following [Carrell and West \(2008\)](#), I estimate  $\sigma_\theta^2$  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  $t' \neq t$ :

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

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

Table 7 presents estimates of total and signal standard deviations.<sup>42</sup> 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 7 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 per-

<sup>42</sup>Two modifications to this procedure yielded notably different results. First, I estimated  $\sigma_\theta^2$  using student, rather than classroom-averaged residuals. I computed the average covariance of all residual pairs between student  $i$  in teacher  $j$ 's classroom  $c$  and  $i' \neq i$  in teacher  $j$ 's classroom  $c' \neq c$ . Estimates of signal variances were remarkably similar under this alternative method. Estimates of total variance in individual student residuals were 2 - 3 times the size of those shown in Table 7. Second, I estimated equation (4) without school-by-year effects. Computed signal variances were about 25 percent larger under this method. The difference may be due to interpretation - the preferred, reported signal variance reflects the variance of teacher quality within schools, whereas the alternative reflects the variance across schools. The latter would be expected to be larger, but the difference was probably driven in part by sorting biases across schools.

cent of total variation, suggesting that differences in teacher quality accounted for much, but not all, of the variation in class performance within schools. Table 7 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 construct a simple Bayesian shrinkage estimator to account for sampling error in class residuals attributed to teacher quality. I use estimates of signal and noise variance listed in Table 7, 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 are scaled by less, since their residuals are expected to be less affected by sampling error.

In section IIIA, I showed that a high rate of charter movers were uncertified and under-qualified. This would not be problematic for charter schools if certified and uncertified teachers had the same underlying distribution of teaching quality, so long as charters did not draw heavily from the lower end. North Carolina’s policy of relaxing licensure requirements for charter schools could be questioned if unlicensed charter movers were heavily drawn from the lower end of schools’ performance distributions. But if not, low licensure requirements may be one way to retain effective teachers in public education. In agreement with [Kane et al. \(2008\)](#), I find little observable difference in teacher quality distributions between licensure groups, but a fairly wide (albeit scaled) variance within each group. For both subjects, Wilcoxon rank-sum tests failed to reject the hypotheses that teachers with regular and temporary licenses were drawn from the same distribution of persistent teacher quality. Figure 4 plots comparative

densities of teacher quality by charter participation. The persistent quality distribution for future charter teachers was significantly lower than that for exclusively mainstream teachers, especially for math. Figure 4 provides further evidence that teachers flowing into the charter sector typically had lower relative class performance within their schools than exclusively mainstream teachers.

## IV. Conclusions

A founding purpose of North Carolina’s charter legislation was to “create new professional opportunities for teachers”.<sup>43</sup> I examine the value that mainstream teachers brought with them when they took advantage of these opportunities and moved to charter schools. In terms of resume line-items like experience, education, licensure, and licensure test scores, I find mixed evidence that charters were hiring good teachers away from mainstream schools. Teachers moving to charter schools were more likely to be inexperienced, but they were also more likely to have at least twenty-five years of experience. Among regularly licensed teachers, the licensure test scores of charter movers were better than those of mainstream movers. But a large minority of teachers without regular licensure attenuated the average qualifications of charter movers. Low licensure standards for charter faculties had the consequence of drawing into the charter system a high rate of uncertified teachers, some of which may have been nearing the expiration of temporary licenses and running low on career options in mainstream schools. Alternatively or temporarily licensed teachers are not necessarily bad teachers (Goldhaber (2007); Kane et al. (2008)), although in North Carolina they are associated with lower student achievement (Clotfelter et al., 2007). I find no significant difference in persistent teacher quality between broad licensure types, but a wide range of quality within each type. Ideally, charter schools would recruit uncertified teachers who were high in the quality distribution but unable or unwilling to attain traditional certification. This would help to retain effective teachers in public schools. Some states allow charter teachers to meet a compro-

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<sup>43</sup>N.C. General Statute 115c-238.29a(4)

mised certification standard (much like the federal standard for Highly Qualified uncertified teachers), contingent on their education, teaching experience, and performance on alternative certification exams. To the extent that these signals are correlated with underlying teacher quality, compromised certification standards would induce charter schools to attract relatively high-quality uncertified teachers from mainstream schools.

For a limited sample of grade 3 - 5 teachers, I estimate measures of teacher quality using classroom performance on standardized end-of-grade exams. Were charter schools cream skimming more effective teachers? Charters were not skimming above-average teachers from the stock of school faculties, although according to the more parametric classroom performance analyses of section IIIB, charters may have been drawing higher-ranked teachers from the flow of teachers changing schools. This is not to say that the teachers who moved to charter schools held a common deficiency in class performance. I show that the distribution of future charter teacher quality, even when its persistent component was formally dissected, was wide and largely overlapped the quality distribution of teachers who never taught in a charter school.

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TABLE 1

## NORTH CAROLINA CHARTER SCHOOLS, STUDENTS, AND TEACHERS, 1998-2007

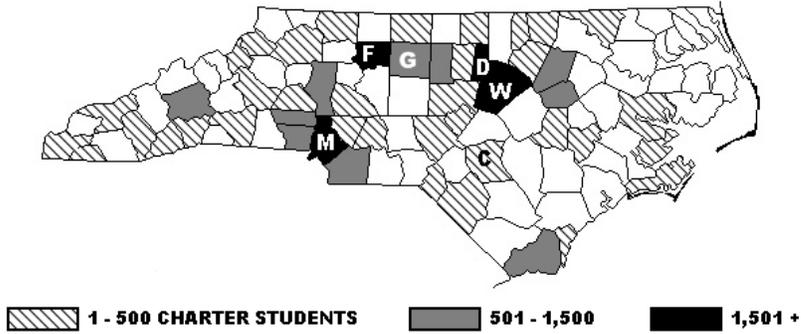
YEAR	SCHOOLS (%)	STUDENTS (%)	TEACHERS (%)
1998	34 (1.7)	4,642 (0.4)	322 (0.4)
1999	57 (2.7)	8,486 (0.7)	595 (0.8)
2000	76 (3.6)	12,654 (1.0)	856 (1.2)
2001	90 (4.1)	15,523 (1.2)	1,080 (1.4)
2002	93 (4.2)	18,235 (1.4)	1,286 (1.6)
2003	93 (4.2)	20,420 (1.5)	1,385 (1.7)
2004	93 (4.12)	21,955 (1.6)	1,504 (1.8)
2005	97 (4.3)	25,248 (1.8)	1,665 (1.9)
2006	97 (4.2)	27,384 (1.9)	1,786 (2.0)
2007	92 (3.9)	27,587 (2.0)	1,890 (2.1)

NOTES: Each count of charter schools, students, and teachers represents the indicated percent (%) of all public schools, students, or teachers in the sample. School and student counts were tabulated from NCES Common Core data. Teacher counts were tabulated from the teachers' panel, described fully in section IIB.

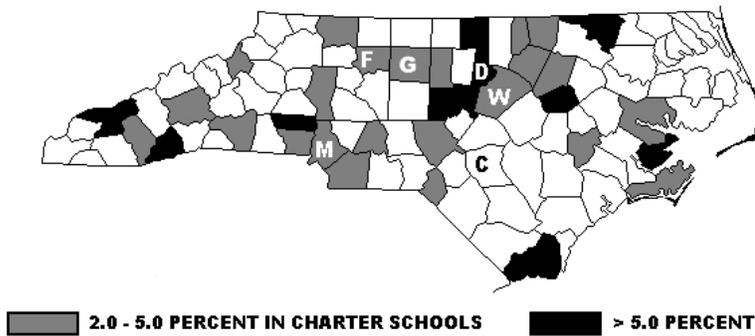
FIGURE 1

2006 CHARTER ENROLLMENT AND PENETRATION

Charter enrollment, by county



Charter penetration, by county



NOTES: Major population centers are in Cumberland (C), Durham (D), Forsyth (F), Guilford (G), Mecklenburg (M), and Wake (W) counties.

TABLE 2

## 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

*n* = 5,346 teachers

NOTES: The percent of all charter participants who followed each mobility pattern is indicated at right. The first two 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 following four patterns apply to teachers who taught in charter and mainstream schools.

TABLE 3

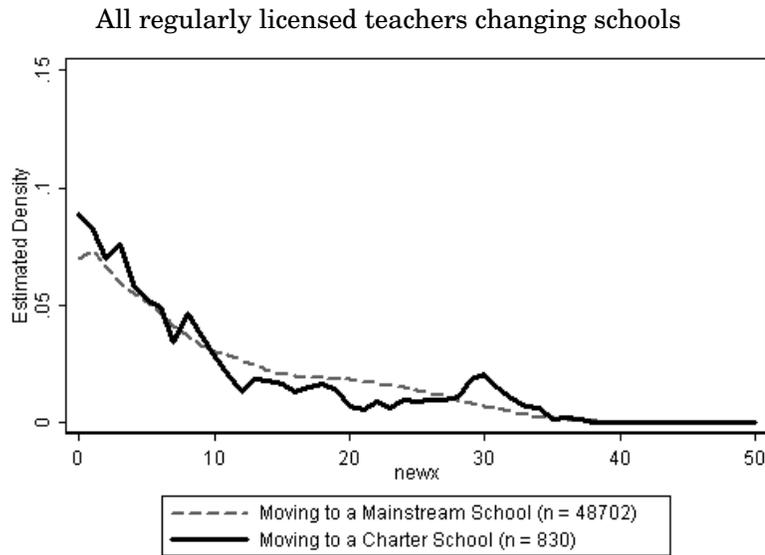
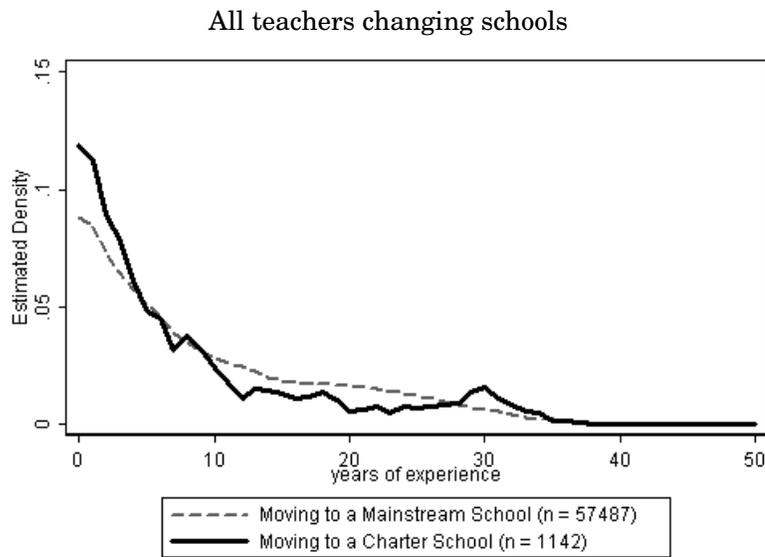
## NORTH CAROLINA PUBLIC SCHOOL TEACHERS: SUMMARY STATISTICS

QUALIFICATION	all teachers	all movers	mainstream movers	charter movers
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)
regularly licensed (%)	89.5 (30.7)	88.8 (31.6)	89.0 (31.3)	79.1 (40.7)
mean licensure test score	0.030 (0.857)	0.015 (0.839)	0.015 (0.838)	0.029 (0.905)
experience (years)	12.6 (9.85)	9.19 (8.73)	9.21 (8.72)	7.94 (9.09)
experience $\leq$ 3 years (%)	21.3 (41.0)	33.2 (47.1)	33.1 (47.0)	41.0 (49.2)
experience $\geq$ 25 years (%)	23.8 (42.6)	12.1 (32.6)	12.0 (32.5)	17.7 (38.2)
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)
<i>n</i> (teacher-years)	886,343	58,629	57,487	1,142

NOTES: Standard deviations appear in parentheses below each mean. Data for "Moving" teachers were evaluated in the year immediately preceding a school change.

FIGURE 2

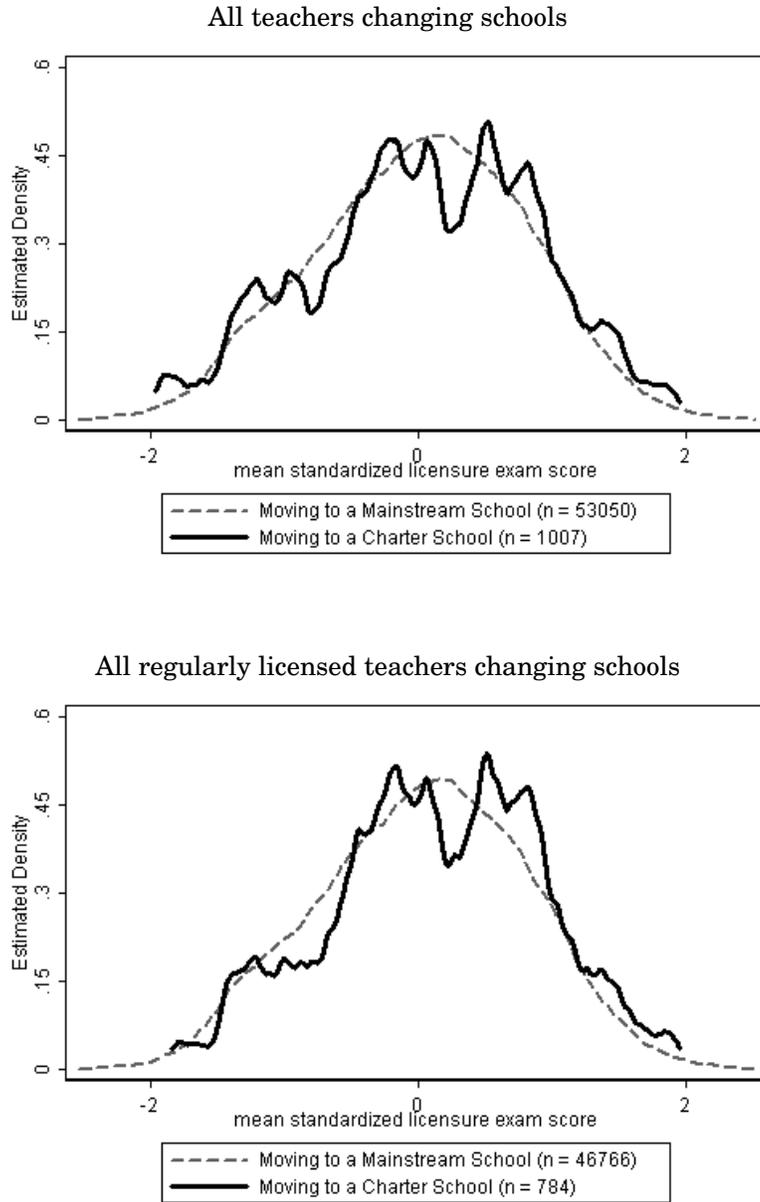
DENSITY ESTIMATES: YEARS' EXPERIENCE OF MOBILE TEACHERS,  
BY LICENSURE AND CHARTER/MAINSTREAM DESTINATION



NOTES: The figures plot kernel density estimates of the years' experience of teachers changing schools. The lower panel is restricted to regularly licensed (certified) teachers, who make up 89.5 percent of the sample with non-missing license data. Densities were estimated with Epanechnikov kernel functions and halfwidths of 0.50 years.

FIGURE 3

DENSITY ESTIMATES: LICENSURE TEST SCORES OF MOBILE TEACHERS,  
BY LICENSURE AND CHARTER/MAINSTREAM DESTINATION



NOTES: The figures plot kernel density estimates of the mean licensure test score of teachers changing schools. Licensure test scores were scaled to have mean zero and standard deviation one within each test code and year. A teacher's mean standardized licensure test score is the average of all unique exam scores. The lower panel is limited to regularly licensed (certified) movers. Densities were estimated with Epanechnikov kernel functions and halfwidths of 0.05 standard deviations.

TABLE 4

ESTIMATED QUALIFICATIONS OF MOBILE TEACHERS,  
BY LICENSURE AND CHARTER/MAINSTREAM DESTINATION

sample	I	II	III	IV
	all NC teachers		licensed NC teachers	
type of mover (equation (1) coefficient)	mainstream mover ( $\hat{\delta}_{jt}^m$ )	charter mover ( $\hat{\delta}_{jt}^c$ )	mainstream mover ( $\hat{\delta}_{jt}^m$ )	charter mover ( $\hat{\delta}_{jt}^c$ )
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 $\leq 3$ years	0.132 (58.29)	0.070 (4.58)	0.120 (51.97)	0.049 (2.90)
experience $\geq 25$ years	-0.102 (65.22)	0.070 (5.86)	-0.100 (60.91)	0.059 (4.37)

$n = 886,343$  teachers

NOTES: Column I lists the estimated difference in qualification  $k$  between teachers moving to mainstream schools and non-movers ( $\delta_{jt}^m$  in equation (1)). Cells in column II list the estimated difference in  $k$  between charter and mainstream movers ( $\delta_{jt}^c$ ). 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 5

NORTH CAROLINA PUBLIC SCHOOL TEACHER FIXED EFFECTS:  
SUMMARY STATISTICS

FIXED EFFECT ESTIMATES	all teachers	all movers	mainstream movers	charter movers
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 6

CLASSROOM PERFORMANCE OF TEACHERS CHANGING SCHOOLS,  
BY LICENSURE AND CHARTER/MAINSTREAM DESTINATION

sample	I	II	III	IV
	all NC teachers		licensed NC teachers	
type of mover (equation (3) coefficient)	mainstream mover ( $\hat{\delta}_{jt}^m$ )	charter mover ( $\hat{\delta}_{jt}^c$ )	mainstream mover ( $\hat{\delta}_{jt}^m$ )	charter mover ( $\hat{\delta}_{jt}^c$ )
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)

$n = 167,244$  teachers

NOTES: 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.

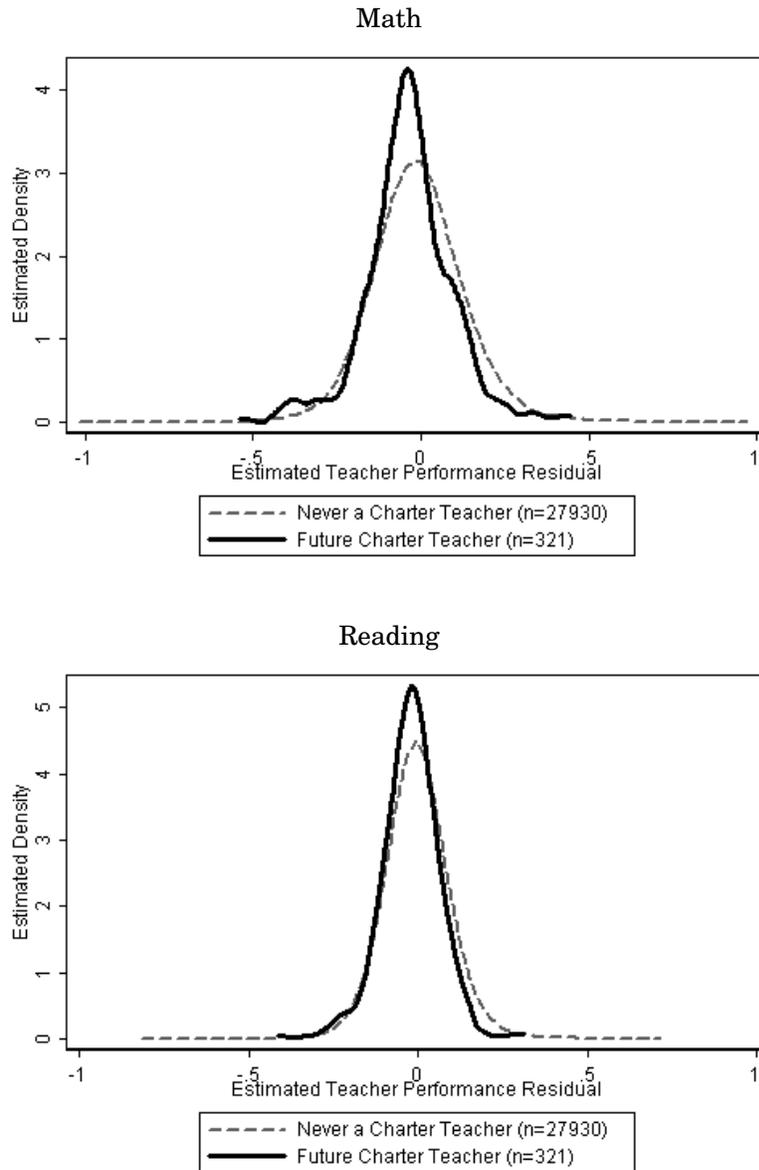
TABLE 7

## VARIATION IN TEACHER QUALITY

	MATH			READING		
	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: 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 4  
PERSISTENT TEACHER QUALITY: ESTIMATED DENSITIES BY CHARTER PARTICIPATION



NOTES: The figures plot kernel density estimates of scaled teacher performance residuals, calculated by equation (6), by charter participation. Individuals who were “future charter teachers”, and those who were “never a charter teacher” were exclusively observed in mainstream schools. All densities were estimated with an Epanechnikov kernel function and halfwidth of 0.025 scaled standard deviations.

