National Board Certification & Teachers’ Career Paths

Does NBPTS Certification Influence How Long Teachers Remain in the Profession and Where They Teach?

Dan Goldhaber
Michael Hansen

information contact
Dan Goldhaber
206-685-2214
dgoldhab@u.washington.edu

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Center on Reinventing Public Education
University of Washington, Box 358774 • Seattle WA 98195-8774
206.685.2214 • www.crpe.org

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National Board Certification & Teachers’ Career Paths: Does NBPTS Certification Influence How Long Teachers Remain in the Profession and Where They Teach?

Abstract: Certification from the National Board of Professional Teaching Standards (NBPTS) represents a significant policy initiative for the nation’s public school teachers as outlined in the No Child Left Behind Act. This paper analyzes how obtaining NBPTS certification impacts teachers’ career paths. Using a competing risks model on data from North Carolina public schools, we find evidence suggesting that National Board Certified Teachers (NBCTs) exit the school, district, and state more frequently than others. These findings are robust to instrumental variables and other tests for robustness. We also employ regression discontinuity methods that support these conclusions, and use this design for further inquiry into the characteristics of teaching assignments for certified teachers relative to unsuccessful applicants. With these tests, we find only limited evidence that NBCTs might utilize the credential to select into teaching assignments with relatively fewer minorities in the student population.

Keywords: teacher turnover; NBPTS certification; public school teacher labor markets; competing risks model; regression discontinuity.

JEL Classification Code(s): I20; J45; C22.

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I. Why Might NBPTS Certification Affect a Teacher’s Career Path?

The movement to professionalize teaching embodied by the National Board for Professional Teacher Standards (NBPTS) is arguably one of the most significant teacher policy initiatives of the last three decades. NBPTS’ expansion and popularity among the profession has been aided through the No Child Left Behind Act of 2002, which established receipt of this credential as one method by which teachers may be recognized as “highly qualified” under the law. The number of teachers who have successfully obtained this credential currently exceeds 63,800.\(^1\) Supporters of NBPTS believe the National Board has played (and will continue to play) a dramatic role in professionalizing teaching, changing the culture in schools in positive ways, and ultimately aiding students’ learning. An important aspect of this program, but not analyzed previously, is how NBPTS might impact schools through its effects on the career paths of teachers who succeed in obtaining this certification.

Ample evidence suggests that teacher quality can have a profound impact on student achievement (Hanushek 1992; Rockoff 2004; Rivkin, Hanushek, and Kain 2005). Furthermore, when judged by any number of qualifications, teachers tend to be inequitably distributed across schools and students, and teachers who leave the profession are the very ones we might wish to keep, at least as judged by their performance on licensure or other tests and the selectivity of the colleges from which they graduated.\(^2\) To the degree that the NBPTS credential affects teacher career paths – how long teachers remain in the teaching profession and in which districts and schools they teach – it could have an important impact on the achievement and distribution of achievement in the districts employing Nationally Board Certified Teachers (NBCTs).

There are a number of ways that the existence of NBPTS could benefit schools. For example, the rewards or recognition that come with being a NBCT may influence high-quality
teachers to stay in the teaching profession longer than they otherwise would. The certificate also signals quality teaching: some evidence (Cavalluzzo 2004; Vandevoort, Amrein-Beardsley, and Berliner 2004; Goldhaber and Anthony 2007), but not all (Sanders, Ashton, and Wright 2005), suggests that NBCTs are more effective in their classrooms than non-certified teachers. This signal of teaching effectiveness would appear to be the immediately tangible benefit of becoming NBPTS certified, as the existing studies showing positive NBCT effects on students do not show that the process of becoming certified itself adds to a teacher’s human capital. This means the easily quantifiable value of NBPTS as an institution, and of the investment by teachers and schools in the certification process, depends largely on whether becoming certified changes a teacher’s career path.³

Of course if there are absolutely no human capital or career path effects associated with NBPTS certification, then the NBPTS credential might simply be an expensive way to recognize already effective teachers (as of 2006, the NBPTS assessment fee is $2,500). And, regardless of their actual impact, there is certainly the perception that NBCTs represent a valuable educational resource and this in itself is likely to impact a teacher’s career path.⁴ The distribution of NBCTs is of interest not only from a teacher quality standpoint, but also from a financial equity standpoint: a majority of states as well as the federal government explicitly promote NBPTS certification by financing or subsidizing the cost of the NBPTS assessment and providing additional compensation for NBCTs—consequently, the distribution of NBPTS teachers across districts and schools indirectly affects the distribution of state resources. For example, North Carolina, the state we focus on in this study, pays the full cost of the NBPTS assessment and provides NBCTs with a 12% salary increase (over the state salary schedule) as long as they remain as classroom teachers.
In short, there are significant reasons to focus on whether the recognition and financial rewards often associated with NBPTS certification do, in fact, influence teacher career paths. In this paper, we use a competing risks model of teacher mobility on public school teacher data from North Carolina to examine how obtaining NBPTS certification impacts public school teachers’ career mobility. In most respects our findings tend to confirm what theory suggests: NBCTs exhibit greater employment mobility than their uncertified peers and are more likely to leave a given school for another school in the same district or another district. To verify that this increased mobility is due to the certification itself and not unobservable characteristics of teachers that determine selection into becoming certified, we employ a regression discontinuity design with the data and find results consistent with the competing risks model. Additionally, we use this regression discontinuity design to analyze differences in later teaching assignments due to certification. Here we find evidence consistent with research on teacher preferences when making a transition: some NBCTs show evidence of moving to schools with lower percentages of minority students. One significant and unexpected finding, however, is that obtaining the NBPTS credential appears to increase the probability that a teacher will leave the North Carolina system.

We begin in the next section by developing a simple model describing how the NBPTS credential might influence a teacher’s career path and providing background on the existing teacher career-transition research. In Section III, we discuss the data and empirical methods used to test our model, and in Section IV we present our findings. In the final section, we focus on the policy implications of the results and offer some concluding thoughts.

II. NBPTS Certification and a Simple Model of Teacher Career Transitions
Most states require teachers to obtain a license prior to actually teaching in a classroom. Commonly, this is referred to as a “teaching certificate,” though it is technically considered a license. Certification from NBPTS is a true certificate—it is not required to participate in the labor market, but it is available to professionals who can show mastery of advanced teaching skills (more on the assessment process will be described below). How this certificate may impact teacher career moves in theory is of primary importance.

A simple model of utility maximization suggests that a teacher is more likely to remain teaching in the profession if the expected lifetime benefits of doing so exceed those of moving to another profession. The same theory applies to the decision to remain in a particular school or district. For simplicity, imagine a case where job transition is costless and individual \( i \) chooses among various jobs, \( j \), in order to maximize the present value of expected utility:\(^5\)

\[
\max_j \text{pv}[u'(T_j,X_i)], \quad \text{given } j \in \{j\}_i
\]  

(1)

Let \( T_j \) be the characteristics of job \( j \) and \( X_i \) be individual characteristics. Further, assume that \( T_j \) is a function of both compensation, \( C_j \), and other non-pecuniary job factors, \( N_j \):

\[
T_j = f(C_j,N_j)
\]  

(2)

Individual \( i \) will opt to pursue a teaching career if the utility associated with the best teaching job exceeds that of the best non-teaching job:

\[
\max_{j \in \text{School}} \text{pv}[u'(T_j,X_i)] > \max_{j \not\in \text{School}} \text{pv}[u'(T_j,X_i)]
\]  

(3)

The financial incentives often associated with NBPTS certification provide a tangible benefit that makes teaching more lucrative relative to other jobs in terms of compensation (\( C_j \)).\(^6\)

Empirical evidence suggests the relative financial rewards and job opportunities in and outside of teaching influence teacher quit rates and the length of time teachers stay in the profession.\(^7\) However, even in the absence of financial incentives, we might expect NBPTS certification to
make teaching more attractive, through non-pecuniary job factors (Nj), by elevating a teacher’s status within the profession; job status has in fact been found to be particularly important in careers like teaching where there are not widely differing salaries (Frank 1985). This model, then, clearly implies that, all else equal, the existence of NBPTS-certification should enhance the likelihood of individuals entering the teaching profession and should encourage NBCTs to remain in the profession longer.

While it should encourage them to remain in the teaching profession longer, it may not keep them in their role as classroom teachers longer. On the one hand, teachers in North Carolina who move out of their role of classroom teacher lose the added NBPTS-associated compensation, and this would discourage them, for instance, from moving to a non-classroom position say, in the central office. On the other hand, the NBPTS credential may signal to school district leadership that an NBCT would, for example, make a good instructional leader and therefore open up additional attractive (possibly higher paying) career possibilities.

It is a stated goal of NBPTS to “[c]ontribute to the equitable distribution of resources by making the placement of accomplished teachers a more overt process,” (Baratz-Snowden 1990, p. 24) but our model suggests that it may do otherwise. Teachers have been shown, all else equal, to prefer working in schools with smaller minority student populations and larger higher-achieving student populations (Hanushek, Kain, and Rivkin 2004; Stinebrickner, Scafidi and Sjoquist 2005). When controlling for degree and experience levels, teacher salaries do not vary much within school districts (and sometimes within states) while the non-pecuniary aspects of teaching jobs vary considerably (Loeb and Page 2000). Thus, to the extent that being NBPTS-certified enhances a teacher’s job market bargaining power we would expect that, at least within districts (since the wages are the same regardless of the work environment of a given school
within that district) teachers will optimize their non-pecuniary compensation by choosing to work in more-advantaged schools.⁸

A school district’s reaction to the presence of NBCTs is less clear. Since NBCTs are perceived as an educational resource for districts, districts certainly have more opportunities available for a high-quality teacher than for those whose quality is uncertain; however, the direction of districts’ preferences in assigning that teacher is uncertain. For example, districts may try to lure teachers with compensation above and beyond the state’s 12% salary supplement. Additionally, district leaders might try to get their “best” teachers into disadvantaged schools that are most in need of help, but they likely also face pressure from parents who may wish to have their children taught by NBCTs. The ways in which school and district preferences lead to the sorting of teachers are therefore unclear. For this reason, along with the fact that changes in school demographics are largely outside of a school’s control, we do not offer a hypothesis for the effect the NBPTS credential has on the time that NBCTs remain in a particular school.

The bottom line is this: while it is a policy goal of NBPTS to create a more-equitable distribution of resources – in this case, high-quality teachers – state and district policies may not necessarily support that goal. On the contrary, given teachers’ preferences, state and district policies may enable teachers to move in such a way as to exacerbate inequalities in the school system; whether this happens or not is an empirical question we seek to address here.

III. Data and Empirical Methods

The primary data for this study is extracted from administrative records of teachers and students maintained by the North Carolina Education Research Data Center (NCERDC) for the North Carolina Department of Public Instruction of (NCDPI). These data include detailed teacher characteristics for over 70,000 teachers per year. A subset of the teacher records can be
matched with data from the Educational Testing Service (ETS) that includes information on which teachers applied to, and were certified by, NBPTS during the period of 1997-2000. All of these data are matched to the U.S. Department of Education’s *Common Core of Data* to obtain school- and district-level characteristics, and to a survey of local school district officials detailing the *local* incentives, both financial and non-monetary, offered to NBCTs.

North Carolina is an ideal state for this study: the state funds the application fee for all first-time NBPTS applicants (and will also fund applicants applying for a retake if not funded previously) and provides a 12% salary supplement to teachers who obtain NBPTS certification. Not surprisingly, given these incentives (which are among the most generous in the United States) North Carolina has the most NBCTs of any state in the country. More importantly, the North Carolina data permits the tracking of teachers over time, so it is possible to follow them as they progress in their careers and determine how NBCTs compare to non-NBCTs in terms of length, district, and school of employment.

The NCDPI records include all teachers and students in the state over a 10-year period (covering school years 1994-1995 though 2003-04). The teacher data include demographic information, degree and experience levels, licensure status, the college from which the teacher graduated, and the teacher’s performance on one or more licensure exams. We restrict our sample to full-time teachers who have taught for at least 3 years and less than 30 years. We opt for these restrictions since teachers with less than three years experience are not eligible to be NBPTS certified and we wish to limit the number of teacher exits that are due to retirements. This yields a sample of 575,619 teacher observations consisting of 109,416 unique teachers.

A teacher is classified as an NBCT from an indication on the teacher’s payroll records as receiving the state’s 12% salary supplement. Our sample contains a total of 15,759 NBCT
observations and 5,920 unique NBCTs. **Table 1** reports sample statistics for select variables by NBPTS status for all teachers observed during 2003-04, the last school year included in the analysis.

*(Table 1 about here)*

Consistent with prior research, we find that NBCTs are more likely than non-NBCTs to be female, hold a graduate degree, and have above-average performance on a state licensure test than non-NBCTs, and significantly less likely to be African-American (Goldhaber, Choi, and Cramer, 2007). It is also notable that NBCTs tend to be teaching a lower percentage both of minority students and of students eligible for free or reduced-priced lunch.

For a subset of teachers in our dataset (those who appear in the data between the years 1997-2000), we have supplementary data from ETS that provides information on teachers who applied to NBPTS, which includes the scores each applicant received on the 10 sub-assessments that comprise the certification process. This information allows us to compare successful and unsuccessful applicants to NBPTS and investigate applicant career paths along the continuum of performance on the NBPTS assessments. Within this dataset from ETS, we successfully link 2,971 unique NBPTS applicants to our primary data, of whom 1,434 passed on the initial attempt and an additional 319 passed on successive attempts within the four-year time span of the data (in total, 1,753 applicants eventually passed the exam). Additional information pertaining to NBPTS certification is detailed in the Appendix A, including details of the process and the experience distribution of applicants in this sample.

**Table 2** presents summary information (by NBPTS application status) on the percentage of teachers making one of five specified year-to-year transitions: 1) choosing to remain at the same school, 2) taking another teaching position at a different school within the same district, 3)
taking a teaching position in another district within the state, 4) leaving employment in North Carolina public schools (this includes those who left public school teaching in North Carolina and those who left the state), and 5) moving from a teaching position into an administrative position.

(Table 2 about here)

The data are categorized by experience level and into three groups: those who never apply for certification during our sample period; those who apply for certification at some point during our sample period; and those who apply for certification and successfully attain NBPTS certification during our sample period (this group is a subset of the applicant group). Observations in this table represent unique teachers in our data who meet the specified experience and certification criteria.

We classify teachers as applicants here and throughout the remainder of the analysis if they apply at any point during the sample period, based on the premise that teachers who ultimately apply to NBPTS may be different than non-applicant teachers even before they actually opted to apply; however, the findings reported in Table 2 (and below) are qualitatively similar when we classify teachers as applicants only in the year in which they actually apply to NBPTS. Teachers are classified as NBCTs in the year in which they are publicly recognized as being NBPTS certified, as the credential does not likely impact a teacher’s career path directly until it has been officially bestowed upon her.

Several noteworthy patterns emerge from a casual examination of Table 2. First, NBPTS applicants at all experience levels appear to be less likely than non-applicants to leave their own schools, and far less likely to leave the NC public school system (the differences between groups are statistically significant). For example, 66% of NBPTS applicant teachers with 12-20 years of
experience remained in the same school over the period versus about 58% of non-applicants. Second, when applicant teachers do move, they tend to do so within the school system whereas non-applicants tend to move out of the system rather than within the system. At all levels, applicants are generally more likely than non-applicants to make transitions within the school system (school and district moves), but there are no consistent patterns in differences between successful applicants and non-applicants generally. Third, while applicants in general are more likely than non-applicants to stay, there are notable differences within the applicant group: successful applicants (certified teachers) at the early- and mid-career levels are more likely than the applicant group as a whole to leave their school or the state.

Finally, we note that only a small proportion (<0.4%) of teachers in general are observed to move to an administrative position in either the school or district, and in our sample, only two of the NBPTS applicants were observed making this type of career move. This is somewhat surprising, as surveys of NBCTs suggest that career progression is one factor in the decision to seek NBPTS certification (Kelley and Kimball 2001). Though it’s certainly possible that once certified, a teacher may opt to teach for a few years before moving into an administrative post, longer-term observations (beyond the 2000-2001 school year) of the teachers in our sample do not suggest that NBCTs are more likely than other teachers to move into administrative posts, and even suggest they may be less likely to make such a move. A noteworthy aspect of such a transition is that a certified teacher would forgo the 12% teacher salary supplement by moving into an administrative position, as this supplement is only for those who hold the NBPTS certification and actively teach. The loss of this incentive may offer some explanation for the low proportion of NBCTs who make this move. Given the small number of NBCTs who move into
administration, we cannot make any inferences about this transition and thus omit this move from the remainder of our analysis.

A. Competing Risks Hazard Model

As Table 1 illustrates, there are important individual and teaching-context differences between NBCTs and non-NBCTs. Thus, to assess the effects of obtaining the NBPTS credential, we begin by estimating a discrete-time competing-risks model (following Boyd et al. (2005) and Imazeki (2002)) to study the role NBPTS certification may play in influencing teachers’ career transitions over time:

\[ h_j(t | X, T, \text{NBC Status}) = k_j(t) \exp(X_t \beta_1 + T_t \beta_2 + \text{NBC Status} \beta_3) \]  

for \( j \in \{\text{school exit, district exit, and state exit}\} \)

In this model we estimate the hazard of making each of these respective exits \((h_j)\) at a given time in a teacher’s career using a vector of individual characteristics \((X_t)\) as well as school and district factors associated with the teaching position \((T_t)\). We include this vector of characteristics, many of which are time varying, to control for the impact of exiting due to other reasons. In the analysis, we primarily focus on the influence of NBPTS certification status on career decisions by using measures of both applying for and successfully passing the exam.

Lastly, we recognize that receiving NBPTS certification likely impacts teachers differently depending on the stage of their career due to the nature of the certification, which provides professional and financial benefits to the holder over its 10-year lifetime. Accordingly, we employ this competing-risks model with three distinct experience classes: (i) a cohort of early-career teachers who have completed 3 to 11 years of teaching, (ii) a cohort of mid-career teachers who have completed 12 to 20 years of teaching, and (iii) a cohort of late-career teachers who have completed 21 to 29 years of teaching. In this model, entrance into the study occurs
when a teacher meets the lower experience limit of a cohort; thus, we assume a baseline hazard function for each exit type for each cohort of teachers, with experience levels held constant. Accordingly, the upper limit in each of these cohorts is not explicit, but rather implied by the time span of our data. Because we observe teacher moves by comparing changes from one year to the next and have teacher data as a yearly snapshot, the last year that we can assert teacher moves is 2003, giving an effective eight-year span of career transition observations for teachers entering the cohort in 1995.

B. Comparison of Successful and Unsuccessful NBPTS Applicants

A central assumption of the competing risks model specified above is that a teacher’s certification status is random, or at least uncorrelated with other unobservable qualities that affect teacher mobility. This is likely unrealistic since obtaining a certificate is a choice the teacher chooses to pursue and likely does so in the interest of accelerating her career. Thus, we suspect these estimates of the impact of NBPTS status are likely biased by this pre-existing tendency for career movement. We attempt to counter this implicit bias by also controlling for a teacher’s application status, which is an omitted variable under the first specification.

As mentioned above, we have detailed test information on everyone from North Carolina who applied for NBPTS certification for a subset of our data (spanning the 1996-97 school year to the 1999-2000 school year). Thus, we also estimate a variant of equation (4) above where we also include an indicator variable for whether an individual applied for the exam. Because all applicants demonstrate a similar motivation to put forth at least a minimal cost of time and effort to complete the examination process, we feel the comparison between successful and unsuccessful applicants is at least as good as the original comparison, and likely better. Thus, we
view the comparison between successful and unsuccessful applicants as a more informative gauge on the effects of NBPTS certification on a teacher’s career path.\textsuperscript{16}

Additionally, since these data on NBPTS applications are only available for a subset of the overall time span, we run the analysis for this sample only through the 2000-2001 school year, the last year that we can confidently assert moves for these applicants without introducing other unknown applicants. Findings of these competing risks models are laid out in Section IV below.

While the comparison between successful and unsuccessful NBPTS applicants is likely to mitigate some of the selection bias arising from unobserved variables that are correlated both with teachers’ career paths and their NBPTS status, we attempt to further address this issue by employing instrumental variables and regression discontinuity methods. First, we instrument the endogenous variables on applying and obtaining certification with others that are correlated with these values, but are not correlated with teachers’ career mobility. This method enables us to remove the endogeneity from our estimates on these variables, and we obtain unbiased estimates for these values in the context of the entire labor market.

Second, we use a regression-discontinuity design, which is a quasi-experimental method. Employing such a design for the problem eliminates the potential bias due to unobservable differences among applicants and provides a method to test the causal effects of obtaining certification on teachers’ career paths.\textsuperscript{17} In the framework of the NBPTS exam, applicants are evaluated on 10 different sub-assessments, for which scores of 275 and over pass. This is a sharp cutoff, meaning no applicants who scored above (below) this break point failed (passed), and it forms the basis for comparison in this design.
The regression-discontinuity model explicitly recognizes that teachers’ preparedness and performance on the exam are not random events, but are largely determined by the applicants themselves through means unobservable to the econometrician. Further, certain teacher attributes such as race, gender, school demographics, and licensure score are all associated with higher scores on the NBPTS exam—thus, the expected distribution of scores is reasonably predictable (Goldhaber and Anthony 2007). An applicant’s precise final score, however, may be considered random in that the score on each sub-assessment that determines the overall score will have some random error associated with it—particularly because some of the sub-assessments are based on subjective assessments on the quality of, for instance, a candidate’s teaching practices. Because of an applicant’s inability to choose her final score with certainty, assignment to passing status is a random event around the cutoff point.

By exploiting this random assignment around the cutoff, we can utilize the quasi-experimental design of regression discontinuity to determine an average treatment effect, which is the effect on teachers’ careers due to passing the exam, estimated with the following model:

\[ y = S \beta_1 + D \cdot I_{(Pass)} \beta_2 + I_{(Pass)} \beta_3 \]  

(5)

where the dependent variable is a post-test realization of some variable of interest (y), regressed on some specified polynomial order of the standardized test score (S), an interacted polynomial expansion for those who pass \((D \cdot I_{(Pass)})\), and an indicator for passing the exam \((I_{(Pass)})\). The polynomial expansions provide a continuous function as a baseline for comparison, thus any resulting discontinuity in the post-test dependent variable is attributable to passing the exam. As long as the data meet certain continuity conditions, the average treatment effect \(\beta_3\) is now identified as a direct result of passing the exam; thus, passing the exam is determined to be causal in this circumstance.
We wish to note that in our analysis we only consider the first attempt of each applicant and exclude any exam retakes, as retakes potentially violate the continuity condition necessary for proper identification in the regression discontinuity design. Because unsuccessful applicants may bank some of their sub-assessment scores and retake only the portions they did poorly on, we expect outcomes for retakes to be less random than those for initial attempts. In our data, just less than 50% of applicants passed on an initial attempt, while those who reapplied within the time span of our data set (constituting 39% of those who failed) had a passing rate of over 55%. Accordingly, the control group in this design is the group of initially unsuccessful applicants, and those receiving treatment are those who obtained certification on their first attempt.

In our analysis, we use this regression discontinuity approach in three different ways. The first is used as a robustness check on the competing risks model, in which we estimate the competing risks model with a regression-discontinuity style approach of using the distribution of the test score to control for career moves. Our second use is the more traditional static regression approach common to this methodology, in which we test the likelihood of both successful and unsuccessful applicants in making a specified career move within a certain window following application to NBPTS. Our final use is also a traditional approach that we use to analyze differences in the types of teaching assignments certified teachers obtain vis-à-vis their unsuccessful counterparts.

We consider exit decisions made at increasing intervals after becoming certified, as a focus on a single year after receiving certification may be overly restrictive of the time frame in which NBPTS certification has an impact on teachers’ mobility. Opening this window of movement to multiple years beyond certification, however, will present us with a trade-off in the quality of our estimated impacts. Examining exit decisions made several years after certification
gives a more complete estimate of the total impact on teacher mobility; however, enlarging the time frame also introduces a bias into our control group by including those who initially failed the NBPTS exam but later reapplied and passed. As noted above, only the initial test outcome is considered for this design, and those who fail their initial attempt comprise the control group for this design. But, any teacher who eventually passes the NBPTS exam—regardless of whether her initial attempt was successful or not—is receiving a treatment, though receipt of the treatment may be delayed by a year or more. Since some of those who originally failed are part of the control group and may pass on a later retake, their inclusion will tend to decrease the magnitude of any observed difference between the control and treatment groups (assuming the treatment effect is not dependent upon the number of attempts required to pass the assessment).

In summary, the shorter-term estimates are unbiased measures of the treatment effect due to passing the exam, though they likely represent a lower-bound estimate of the total NBPTS impact because they restrict movement to a shorter period of time. The longer-term estimates can capture more of the total impact of NBPTS certification on teacher transitions over time, but error is introduced into our control group, biasing the magnitude of the difference toward zero. Thus, all of the regression discontinuity results are likely to be lower-bound estimates of the impact of NBPTS certification on teachers’ career paths.

IV. Results

A. The Impact of Obtaining Certification

We present the results of the competing-risks models for the variables of interest in Table 3. The findings are reported for teachers of varying experience levels and are broken out by teacher race. We estimate the results separately for white and African-American teachers, since prior evidence shows there are significant differences in the likelihood of certification by teacher
race (Goldhaber and Anthony 2007) and this may indicate differential selection into NBPTS status by race. We separately report the effect of NBPTS status on a move from one school to another within a district (columns 1 and 2), the effect of a move from one school to another between districts (columns 3 and 4), and the effect of a move out of the North Carolina public school system (columns 5 and 6). Recall also that we analyzed two separate model specifications: the first model makes use of the full time span of the data and contains an indicator on holding the NBPTS certification only (columns 1, 3, and 5), the second model restricts the time span to all observations through 2001 and contains indicators for both being an applicant and for obtaining certification (columns 2, 4, and 6).

(Table 3 about here)

The estimates reported in the table are hazard ratios—a value greater (less) than one means the variable increases (decreases) the likelihood of making a specified exit, all else equal. A hazard ratio of one implies the variable has no effect on the baseline hazard. While the estimates are not reported in the table, each of these models also includes the covariates noted at the bottom of the table.

Prior to discussing the findings, we wish to corroborate our results with those previously documented, as they are largely consistent with the extant literature. Specifically, our results suggest that teachers working in assignments with higher numbers of low-income and minority students are at significantly greater risk of making any type of move (Rivkin, Hanushek, and Kain 2005). Increased district salaries or instructional expenditures decreased the risk of a teacher exiting a school, and, not surprisingly, teachers with less experience are found to be more volatile, in the sense that they are more likely to leave their school for another option. We also find consistent evidence of higher-ability teachers (as measured by teacher licensure scores in
our analysis) having an increased risk of exiting the profession when teaching among lower-performing colleagues (Podgursky, Monroe, and Watson 2004).^20

Finally, recall that in addition to the 12% salary supplement offered by the state to NBCTs, a small minority of school districts offers an additional financial incentive (either a one-time bonus or a permanent salary supplement) to teachers who become NBPTS certified. We experimented with including information in our models on the magnitude of the bonus or salary supplement that individual districts offered to teachers who become certified. Surprisingly, we find little consistent evidence that these within-state incentives have an impact on the hazard that a teacher leaves a particular school. This finding that additional compensation for NBCT status does not significantly decrease the hazard of leaving a school or district may be due to an unobserved correlation between current financial incentives and unobserved (undesirable) aspects to a particular teaching assignment. Further, the incentives are generally small and may not fully compensate teachers for non-pecuniary job characteristics. In fact, the largest incentives offered (a $2,000 salary supplement or $2,000 one-time bonus) are far smaller than the differentials that some researchers estimate are necessary to entice teachers to teach in disadvantaged school settings (Hanushek, Kain, and Rivkin 2004).

Turning to a focus on the NBPTS variables presented in Table 3, we first inspect columns 1, 3, and 5, which include only an indicator for NBCT status on the full period. Looking specifically at moves within the state school system (columns 1 and 3), we see evidence, mostly significant, among white teachers in the state that obtaining the NBPTS certification is correlated with increased teacher mobility between assignments. The size of the effect is also substantial—estimates ranging from 30% to 132% more movement than non-NBCTs—suggesting the impact
of receiving the NBPTS credential may increase the opportunities available to these teachers, which could then motivate them to make these moves.

Examining the hazard ratios on exiting the state (column 5), we cannot draw any general conclusions about these estimates, as they are inconsistent in sign at the early- and mid-career levels, and only in the case of late-career teachers do we see significant evidence of certified teachers staying in public school teaching longer than those who are not certified. One may expect that attrition from the state would generally be lower among NBCTs, as they are given a substantial incentive by the state to remain in the profession, but this is not borne out in the data.

B. Controlling for Applicant Status

In columns 2, 4, and 6 of Table 3, we report findings from model specifications where an indicator has been added for whether teachers applied to NBPTS. This is an important comparison, since teachers who become NBPTS certified are likely to be different from non-certified teachers in important and perhaps unobservable ways. In these models the NBPTS-applicant coefficient is the differential between applicants and non-applicants to NBPTS, the NBCT coefficient is the differential between successful and unsuccessful applicants to NBPTS, and the multiple of the two coefficients is the differential between NBCTs and non-applicants. The estimation period on this model is only through 2001 due to the time span of our available applicant data.

Inspection of the estimates on school moves within districts (in column 2) yields few significant results. A careful comparison between the estimates on application and on obtaining certification, however, suggests that much of the increased movement observed among NBCTs and non-NBCTs (in the first model) may be attributable to being an applicant. In all of the specifications in column 2, the estimate on application status is larger than that of being certified.
In column 4 we report estimates of switching districts within the state. The estimates on obtaining certification for early- and late-career teachers are significant at the 5% level, indicating a discrete impact from obtaining the certification, beyond the applicant’s baseline mobility (the estimate for mid-career teachers is also large, but not significant). Comparison of the two estimates in this column now suggests much of the movement at this level is attributable to the certification, not to being an applicant as was the case in column 2.

The most surprising findings are among those reported in column 6, regarding the hazard of leaving North Carolina public schools. Recall from the first model that we found no significant difference between NBCTs and non-NBCTs when only controlling for certification status. When including indicators of application status, the analysis changes quite drastically. Including this level of control indicates two divergent effects at work in this case. First, and not surprisingly, NBPTS applicants are found to be less likely to leave the system, compared against the reference group of non-applicants (the difference is statistically significant for all experience levels). This is consistent with expectations, as teachers who apply to the National Board are likely to be the ones with a strong attachment to the teaching profession. Contrary to expectations, however, is the statistically significant finding (for early- and mid-career teachers) that successful applicants (NBCTs) are far more likely than unsuccessful applicants to leave the system. The magnitude of this finding is striking: for example, the point estimate suggests that early-career white NBCTs are over 3 times more likely than unsuccessful applicants to leave the state system.

In an attempt to add precision to these estimates, we also present the results on aggregated models containing all three cohorts simultaneously (stratifying by cohort to allow each to have an independent baseline hazard function), and the estimates were consistent with
those presented above. In the case of leaving the NC public school system, we found white applicants as a group about 60% more likely to stay in the system than white non-applicants, but NBCTs (successful applicants) were estimated over two times more likely than unsuccessful applicants to leave (both of these findings are significant at the 1% level).

We also ran each of the models reported above on the African-American teacher population, but due to small cell sizes at each experience level, we are compelled to present their aggregated results only (again stratified by experience cohort). The estimates here are somewhat consistent with those found in the white teacher sample; however, the results are not nearly as significant, and in the case of leaving North Carolina public schools, we cannot show any significant evidence of certified teachers leaving at a greater rate than unsuccessful applicants (the point estimate, however, is large and may fail to be significant due to low power). Due to a very small sample size of applicants obtaining NBPTS certification on their first attempt, we exclude analysis of African-American teachers beyond this point.

We can reconcile the estimates on leaving the state from the first specification, where no significant difference was found, with these findings in the enhanced model, where two significant effects are found, by looking at the product of the estimates. While not exact, the products of the estimates in column 6 approximate the estimates in column 5 (keep in mind that the two model specifications are not exactly comparable, as noted above). The omitted application variable prevents us from finding significance in the first model; however, once we control for application status, we see two divergent effects with greater precision with largely significant results.\textsuperscript{23}

\textit{C. Mobility and Time Since Certification}
Since timing a career transition is likely an important component to obtaining certification, we also experimented with competing risks models identical to those above, with the exception of entering certification status as a series of indicator variables representing the time since becoming certified. The estimates from these specifications are reported in Table 4.

(Table 4 about here)

For brevity, we only report the results from the white teacher model aggregating across all cohorts. Generally, we find that career mobility as a result of certification only does not seem to be particularly time dependent, at least not when controlling for NBCT status only. In the second specification that includes application status (in columns 2, 4, and 6), we see the estimates monotonically increasing with time. Inspection of the estimates on district and state transitions, however, suggests that much of the increase in the hazard function comes at the initial certification period (within the first year of certification); marginal increases in the hazard beyond the first year are not significant.

D. Robustness Tests on Competing Risks Model

While including a control for application in the previous tables does provide further insight on the career paths of NBCTs, it does not fully remove the endogeneity of the decision to apply. To counter this we go one step further and estimate the second model with instrumental variables. Here the indicator on ‘ever being an applicant’ and ‘passing the exam’ were projected onto the other explanatory variables and the following instruments: the percentage of teachers who are current applicants, the percentage of teachers previously NBPTS certified, and the percentage of previous unsuccessful applicants (each of these measures is measured within school and year), along with a quartic expansion of a teacher’s initial score on the NBPTS assessments (centering the cutoff score at zero, with non-applicants’ scores set to zero). Each of
these instruments is strongly correlated with teachers’ decisions to apply and their likelihood of ultimate success, but they are not likely in and of themselves to influence their future career mobility. The instrumented values of application and certification explain 33% and 52% of the variability in the original variables, respectively, so we do lose considerable power in these results; however, with this tradeoff we hope to gain accuracy in our estimates.

The results from this specification are presented in columns 1, 3, and 5 of Table 5 (indicated by IV). The point estimates for moves within the state (columns 1 and 3) are similar in magnitude to those we originally estimated in Table 3, suggesting that any endogeneity bias that determines selection into the group applying to NBPTS may be small. Few of these IV estimates are significant, however, due primarily to the loss of variation in our instrumented variables. Of noteworthy exception are the hazard ratios on leaving the state: though somewhat closer to one (compared to the original estimates), both application and certification estimates are still significant under these specifications and support the original conclusions.

(Table 5 here)

Further, this additional information on the actual score of applicants provides more information than a simple binary pass-fail indicator. As an additional test on the robustness of these findings, we isolate all applicants in our data and test for mobility differences that may arise in these due to the certification, holding initial test score constant. Stylistically, this test is a dynamic version of the regression-discontinuity design discussed above. These estimates now reflect the impact of obtaining the certificate among applicants only, and we follow these through the full time span of our dataset. These results are presented in columns 2, 4, and 6 of Table 5 (labeled RD). The point estimates on within-state moves are trivially smaller than the null hypothesis; however, in the case of leaving the school system all together, the estimate is
large and significant, with more than a 75% increase in the probability of exiting as a result of earning the certificate. These results generally confirm the IV results and are similar to those presented in the second model on Table 3, where we see the largest differences between successful and unsuccessful applicants in leaving the state.

E. Regression-Discontinuity Results

To verify the finding that NBCTs are in fact more mobile than non-NBCTs and that it is not attributable to unobservable characteristics that may be associated with applying for NBPTS certification, we employ a traditional regression-discontinuity approach. We also use this same design to test whether the credential has an impact on the kind of schools where NBCTs teach (as measured by the characteristics of the schools and their student bodies) when compared with those applicants who were not successfully certified.

For the regression-discontinuity models we use the sample of teachers for whom we have information on their NBPTS assessment scores. In these models, the distribution of NBPTS assessment scores serves as a control variable, and any discontinuity observed when controlling for a teacher’s score is determined to be a causal effect of obtaining the NBPTS credential. As before, we estimate the models separately for white teachers only, so as not to misattribute the pre-existing racial differences in the likelihood of becoming certified to the causal effect of obtaining the NBPTS credential.

In Table 6 we report our findings for models identifying a teacher’s probability of exiting a given school within a specified time period after obtaining NBPTS certification (1, 2, 3, or 4 years). In these analyses we categorize move types interdependently (as opposed to the survival model findings reported in Tables 3, 4, and 5, where we categorized the exit types to be mutually exclusive). For instance, in modeling the probability of leaving a school, a teacher
exiting the state (who also simultaneously leaves the school and district) is treated the same as a teacher moving to another school within the district. The reason for this alternate categorization is that the competing risks methodology above explicitly models each specific move type in concert with other exit types and thus incorporates more information into the estimates. Since the regression discontinuity methods only look at each specific exit in isolation, we are compelled to look at the moves in this less-informative approach and not make the distinctions among types that are possible in the competing risks analysis.

These models are based on a polynomial expansion of the applicant’s final score on the NBPTS exam using a logit model and employing robust standard errors clustered on the discrete values of the final score, following Lee and Card (2006). No other explanatory variables were included in the models reported here, as all differentiating characteristics (both observable and unobservable) are, by assumption, controlled by means of the continuity of potential outcomes for applicants on both sides of the cutoff. The sample of white applicants is used to derive these estimates, and only one observation is used for each teacher (initial application performance).

(Table 6 about here)

These results are the estimated marginal probabilities from passing the NBPTS exam (standard errors reported are for the coefficient estimates). Each cell represents a separate estimate of $\beta_3$ from equation (5) above evaluated at the test cutoff, where the dependent variable of interest for each model is a binary indicator representing whether a teacher made the specified move within the given time period. The estimated discontinuities at the cutoff represent an estimate of the marginal effect of obtaining the NBPTS credential on the increase (or decrease) in the likelihood of exiting a particular school, district, or the state.
Given the results of the survival model in the previous sub-section, it is not surprising that we find evidence, largely statistically significant, for white NBCTs to exit the school or district at a higher rate than non-NBCTs (estimates range between 4-11% more likely to make such an exit), further supporting the findings that NBCTs have an increased hazard of within-state transitions as a result of becoming certified. Moreover, the marginal effect on leaving the state also show a consistently increased risk of leaving at all intervals after obtaining certification, and while the first year is not significant, all estimates beyond that are significant, and the magnitude of the point estimates is also substantial—ranging from 3-10%.

A noteworthy point in these estimates is that the percentages reported here are not conditional on the individual’s baseline hazard (as they were in the competing risks model) but are estimated increases in unconditional turnover. For example, our findings suggest that an applicant who scores 275 on the NBPTS assessment faces a 37% likelihood of making a school exit within three years after becoming certified, while an applicant who fails the assessment with a score of 274 faces a 29% likelihood of making the same move (an increase in the conditional probability of nearly 30%). The estimates for exiting the district and state are equally stark. These findings are contrary to our expectations about the impact of such a credential on a teacher’s career path, but generally consistent with the estimated differentials in the competing risks models above.

Next we turn our attention to the nature of the school moves made by those who become certified compared to those who are unsuccessful applicants. In Table 7 we report on models that estimate the effects of becoming NBPTS certified on school characteristics. Here our variables of interest are measures of the percentage of minority students, the percentage of free and reduced-price lunch recipients, and per-student district expenditures, evaluated at increasing intervals.
after passing the NBPTS exam. Descriptive statistics for these school characteristics as well as the distribution among NBPTS-certified teachers can be found in Goldhaber, Choi, and Cramer (2007). As above, each cell in the table represents a separate regression on the impact of being certified. In this study, we further the analysis by seeking to determine the causal effect of obtaining NBPTS certification on the distribution of teachers among schools. The coefficient estimates reported in the table are the marginal effects of becoming NBPTS certified on the attributes of future teaching assignments.

(Table 7 about here)

This test provides few significant findings, however. Notably, some of the estimates that are significant at the 5% level—decreases in expenditures-per-student one and two years after certification—fall into insignificance beginning in year three and even change sign. The percentage of minority students is significantly smaller two years after certification, but insignificant at all other time intervals; however, we do observe some consistency in its magnitude after the second year and fail to detect significance because of our loss of power with time. We also see some consistency in sign of the percentage of free and reduced-price lunch recipients (though not significant) but these are much smaller in magnitude. The findings here suggest NBCTs may move to schools with fewer minority students as a result of passing the NBPTS exam, however our results are not definitive enough to support this conclusion. Additionally, since NBPTS applicants as a group do tend to start from more affluent and homogenous schools, the marginal impact of certification on such characteristics may be somewhat small (hence low power in our analysis may prevent us from detecting statistically significant differences). As explained above, we view these estimates as lower bounds of the
overall effect of attaining certification, so the true effect may be larger, but we have no method to do quantify that.

An important part of the comparisons of new teaching assignments is that these estimates are conditional on a teacher remaining in the state; hence, the power of our estimates decreases over time as our sample size shrinks due to teachers exiting the state. As a result, the estimates presented may suffer from a sample selection bias, since NBCTs have a demonstrated higher likelihood of exiting the state. In the absence of an appropriate instrument to provide some exogenous variation in this case, we cannot predict the direction or magnitude of this bias. Due to this unknown bias, in addition to the inconclusive findings, we are hesitant to make any definitive inferences for the impacts of certification on teacher distribution in schools, and suggest further research into this issue.

V. Public Policy Implications and Conclusions

In most respects the analyses presented here tend to confirm what theory suggests: as a consequence of becoming certified, NBCTs exhibit greater employment mobility within the school system than their uncertified peers. Further, we find trends in our regression-discontinuity results that are consistent with research on teacher preferences when making a transition—NBCTs show limited evidence of moving to schools with lower percentages of minority students; however, our results from these tests are not definitive on this point.

Given the widespread perception that the NBPTS credential is a sign of teacher quality, it is not surprising that NBCTs may be able to leverage this credential to secure more favorable teaching assignments. But, our finding that obtaining the NBPTS credential leads to greater mobility, and that it may subsequently permit NBCTs to alter the kinds of schools in which they teach, raises equity concerns. Existing research suggests that the value of NBPTS certification is
one of teacher quality as opposed to human capital—meaning that schools benefit from having NBCTs in their classrooms, but not directly from having their teachers engage in the certification process itself. In fact, there is some evidence that teachers are less effective while in the process of becoming certified (Goldhaber and Anthony 2007; Harris and Sass 2007). Thus, our findings suggest that schools that already tend to lose teachers—that is, those with higher proportions of minority students—may be harmed by the greater mobility that arises for teachers as a consequence of having a readily identifiable credential ostensibly signaling their quality.

One potential implication of this finding is that state or local policymakers may wish to provide differential financial incentives to give NBCTs greater encouragement to work in disadvantaged schools.28 A recent case study report on the distribution of NBCTs in six states shows that they are far more equitably distributed across schools in California, where NBCTs receive a $20,000 reward for teaching in a low-performing school, than they are in the other five states where the financial incentive is available to any NBCT regardless of teaching assignment (Humphrey, Koppich, and Hough 2005).29 This study suggests that targeted financial incentives are an important component toward a more equitable distribution of NBCTs, but that incentives alone may not be enough, as other working conditions factors (for example, school resources, principal leadership, or collegiality of teaching staff) are also important in determining where teachers opt to work.

We did not find evidence that the varying district-level financial incentives offered to NBCTs had much of an impact on their career paths. These incentives, however, were quite small compared to the 12% pay increment the state offers—far smaller than the aforementioned California incentives or what other research suggests is necessary to influence teacher attrition (Hanushek, Kain, and Rivkin 2004). New research shows that targeted pay incentives can be an
effective way to encourage teachers to teach in higher-poverty settings – in a specific example, an $1,800 incentive for math and science teachers who teach in schools with a higher-than-average percentage of students eligible for free or reduced-price lunch resulted in a statistically significant decrease in the attrition rate of teachers receiving the incentive (Clotfelter et al. 2004).

A significant and interesting departure from what we had hypothesized is that obtaining the NBPTS credential appears to increase the probability that a teacher will leave the North Carolina system. This finding, at least on the surface, is counterintuitive given both the investment of time and energy required to become NBPTS certified and the large salary supplement that NBCTs in North Carolina receive. One possible explanation for this seemingly anomalous finding is that NBCTs leaving the North Carolina system are not by and large leaving the teaching profession. Instead, teachers may be obtaining the NBPTS credential in order to enhance their employment options in other schools outside the public system, or perhaps in other states. Unlike many states, North Carolina is a net importer of teachers so it would not be surprising if many of the teachers in North Carolina work in schools far away from where they were raised and attended high school. Given research showing that teachers tend to be employed “close to home” (Boyd et al. 2005), it would not be surprising if NBCTs are using the NBPTS credential, which meets the No Child Left Behind definition of ‘highly qualified’ under many state teacher certification requirements, as a vehicle to move to a teaching position in another state.
References


Stinebrickner, Todd R., Benjamin Scafidi, and David L. Sjoquist. 2005. Race, poverty, and teacher mobility. Andrew Young School of Policy Studies Research Paper Series #06-51

Appendix A

We wish to provide further information about the experience distribution of NBPTS applicants and those who successfully obtain certification. Figure 1 depicts the experience distribution (kernel density estimates) of teachers by NBPTS certification status. Panel A compares the experience distribution between NBCTs and non-NBCTs as observed in the last year of data available, 2004. Note that we omit teachers from our sample who have less than 3 years of experience since they would be ineligible to apply for NBPTS certification. As shown, the distributions are roughly equivalent, with the distribution of NBCTs shifted towards more experience in the early stages of the teacher’s career. Additionally, application for NBPTS certification drops off somewhat steeply beyond approximately 25 years of experience, and this characteristic reveals itself with a lower density of NBCTs relative to non-NBCTs in the latter stages of teacher careers. Panel B shows a comparison between initial passing status and an applicant’s experience level at the time of initial application. Though these distributions are virtually equivalent, there is some indication of higher failure rates among less-experienced teachers, and conversely, higher passing rates among more-experienced teachers, particularly at the two modes of the distribution. As indicated above, application for the NBPTS exam after 25 years of experience is uncommon, as seen by a steadily decreasing density in both successful and unsuccessful applicants.

(Figure 1 about here)

We also wish to present the timing of the events relevant to obtaining certification. When a typical applicant applies to the NBPTS exam, she undergoes a three-step process of submitting an initial application, verifying candidacy, and ultimately submitting a portfolio and completing the assessments. This process must be initiated by the end of a given calendar year and be
completed by June of the following year—roughly mirroring the traditional school year. NBPTS then evaluates the criteria and returns a decision to the applicants no later than the end of that calendar year, making the whole process from application to outcome approximately one full year (for more information on the application process, please see http://www.nbpts.org/become_a_candidate/assessment_process). Given the length of the process and the typical practice of entering a teaching contract to teach for a full school year, most teachers cannot make any new exit decisions with this information until the second summer after their application. Further, once the exit is made, we cannot evaluate the nature of the change—when measuring the change by such factors as the level of spending per student or the percentage of minority students associated with the teacher’s new assignment—until the following school year is completed. We illustrate this process with a timeline below:

(Figure 2 about here)
Appendix B: Data Appendix

Our data for this study came from three sources:
1) the primary dataset details all teachers in the North Carolina public school system,
2) a supplementary dataset from ETS documenting North Carolina applicants to NBPTS, and
3) the Common Core of Data used to provide supplemental school- and district-level information.

In the paper, we also describe the use of a fourth dataset on local incentives for NBCTs, though none of the estimates presented in the tables draws on this data. Specific details on each of these datasets are provided below.

NCERDC Dataset
The primary data for this study is extracted from administrative records of teachers and students maintained by the North Carolina Education Research Data Center (NCERDC) for the North Carolina Department of Public Instruction (NCDPI). These data include detailed teacher characteristics for all teachers in the state (over 70,000 teacher observations per year) including licensure, pay, classroom assignment, and personnel-file details. The data covers ten school years, spanning 1994-95 through 2003-04. Most of the variables used in the study come directly from the dataset; however, the variables of interest—those indicating teacher mobility—were created variables that reflect mobility within and out of the dataset, which covers the universe of the North Carolina school system. This dataset is proprietary, but interested researchers may inquire about accessing it by contacting Dr. Clara Muschkin, the current director of NCERDC.

ETS Dataset
A second dataset was provided from Educational Testing Service (ETS) that includes information on which teachers applied to, and were certified by, NBPTS during the period of 1997-2000, in addition to scores for each component of the exam. This dataset covers all teachers applying from North Carolina during this period. This dataset was provided to NCERDC, which aided our research by matching these applicants to NBPTS with teachers appearing in the North Carolina dataset and provided us with the encrypted identifiers necessary to link this data in with the NCERDC dataset. This data is also proprietary and we refer interested researchers to ETS for this data.

CCD Dataset
Once we merge the two datasets above, we supplemented the data with school- and district-level characteristics from the Common Core of Data (CCD) available from the U.S. Department of Education. The variables used from this dataset were the numbers of students with particular characteristics (e.g., racial background, eligible for free lunch) in attendance at each school, the locale of the school, as district information on spending per pupil. We transformed the variables indicating student populations with specific characteristics to percentages to reflect the percentages in each school by year. This is a publicly available dataset.

Survey of Local Incentives
Over the course of two years, we conducted our own phone survey of district-level incentives available to NBCTs for all of the districts in North Carolina. For this survey, we called district personnel and asked specific information about these policies, including monetary and non-monetary incentives for becoming NBPTS certified, and how long such policies had been in
place. These policies were then coded and matched to our primary dataset. As reported in the
text, we used this dataset for some empirical testing to determine if NBCTs’ career paths were
substantially altered by the presence of such incentives. Because these tests did not provide any
substantial evidence that this was indeed the case, we omitted these variables from our main
estimation; hence, none of the results presented in the paper use these values. Though the
paper’s results are fully replicable without the data from this phone survey, we are happy to
provide it to any interested researcher upon request.
TABLES & FIGURES
Table 1.
Descriptive Statistics for Teachers in 2003-2004 Academic Year by Certification Status

<table>
<thead>
<tr>
<th></th>
<th>National Board Certified Teachers</th>
<th>Non-certified Teachers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean (Standard Deviation)</td>
<td>Mean (Standard Deviation)</td>
</tr>
<tr>
<td>Individual Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.893 (0.309)</td>
<td>0.792 (0.406)</td>
</tr>
<tr>
<td>African-American</td>
<td>0.058 (0.235)</td>
<td>0.152 (0.359)</td>
</tr>
<tr>
<td>Graduate-degree holder</td>
<td>0.507 (0.500)</td>
<td>0.293 (0.455)</td>
</tr>
<tr>
<td>Average licensure test score*</td>
<td>0.354 (0.770)</td>
<td>-0.003 (0.878)</td>
</tr>
<tr>
<td>School Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secondary school</td>
<td>0.281 (0.450)</td>
<td>0.248 (0.432)</td>
</tr>
<tr>
<td>Suburban locale</td>
<td>0.220 (0.414)</td>
<td>0.189 (0.392)</td>
</tr>
<tr>
<td>Proportion of minority students</td>
<td>0.354 (0.225)</td>
<td>0.412 (0.259)</td>
</tr>
<tr>
<td>Proportion receiving free or reduced-price lunch</td>
<td>0.313 (0.178)</td>
<td>0.371 (0.201)</td>
</tr>
<tr>
<td>District Characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Median housing value</td>
<td>105,065 (30,718)</td>
<td>99,371 (28,125)</td>
</tr>
<tr>
<td>Expenditures-per-student</td>
<td>4,174 (408)</td>
<td>4,137 (361)</td>
</tr>
<tr>
<td>Total observations</td>
<td>5,146</td>
<td>56,615</td>
</tr>
</tbody>
</table>

*Teachers' scores for various licensure tests are standardized against the test distribution, with a mean of 0 and standard deviation of 1, resulting in a single z-score for each teacher. Where the same teacher is observed to take multiple tests, the z-scores are averaged together.
Table 2.
Summary Data on Observed Teacher Transitions Through 2001

<table>
<thead>
<tr>
<th>Experience Level</th>
<th>Certification Status</th>
<th>Stayed in Same School</th>
<th>Switched Schools</th>
<th>Switched Districts</th>
<th>Left NC Public Schools</th>
<th>Switched to Admin.</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>3-11 Years</td>
<td>Non-applicant</td>
<td>43.4%</td>
<td>19.5%</td>
<td>10.1%</td>
<td>34.7%</td>
<td>0.3%</td>
<td>46,354</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>50.7%</td>
<td>30.7%</td>
<td>14.1%</td>
<td>12.3%</td>
<td>0.1%</td>
<td>1,812</td>
</tr>
<tr>
<td></td>
<td>Certified</td>
<td>44.6%</td>
<td>33.8%</td>
<td>16.0%</td>
<td>14.9%</td>
<td>0.2%</td>
<td>823</td>
</tr>
<tr>
<td>12-20 Years</td>
<td>Non-applicant</td>
<td>57.7%</td>
<td>18.0%</td>
<td>6.3%</td>
<td>22.8%</td>
<td>0.4%</td>
<td>33,087</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>66.0%</td>
<td>21.9%</td>
<td>7.0%</td>
<td>8.1%</td>
<td>0.0%</td>
<td>1,433</td>
</tr>
<tr>
<td></td>
<td>Certified</td>
<td>63.0%</td>
<td>24.6%</td>
<td>6.1%</td>
<td>10.0%</td>
<td>0.0%</td>
<td>589</td>
</tr>
<tr>
<td>Over 20 Years</td>
<td>Non-applicant</td>
<td>52.5%</td>
<td>15.3%</td>
<td>3.8%</td>
<td>32.8%</td>
<td>0.4%</td>
<td>28,191</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>66.9%</td>
<td>20.5%</td>
<td>5.0%</td>
<td>10.7%</td>
<td>0.0%</td>
<td>888</td>
</tr>
<tr>
<td></td>
<td>Certified</td>
<td>68.4%</td>
<td>18.8%</td>
<td>5.1%</td>
<td>10.2%</td>
<td>0.0%</td>
<td>532</td>
</tr>
</tbody>
</table>

Note: Observations are unique teachers appearing in the dataset through the 2000-2001 school year meeting the specified experience and certification criteria. Certified teachers are a subset of exam applicants.
Table 3.
Estimates of Hazard Ratio Impacts from NBPTS Certification

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Variable</th>
<th>Moved schools within district</th>
<th>Moved schools between districts</th>
<th>Left NC public schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Early-career teachers</td>
<td>Obtaining certification</td>
<td>1.412**</td>
<td>1.067</td>
<td>1.429**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.115)</td>
<td>(0.182)</td>
<td>(0.169)</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>--</td>
<td>1.154</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.123)</td>
<td>(0.156)</td>
<td>(0.156)</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td>44,352</td>
<td>27,217</td>
<td>44,352</td>
</tr>
<tr>
<td>Mid-career teachers</td>
<td>Obtaining certification</td>
<td>1.303*</td>
<td>1.252</td>
<td>1.443</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.162)</td>
<td>(0.305)</td>
<td>(0.287)</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>--</td>
<td>1.370</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.235)</td>
<td>(0.264)</td>
<td>(0.264)</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td>33,379</td>
<td>18,799</td>
<td>33,379</td>
</tr>
<tr>
<td>Late-career teachers</td>
<td>Obtaining certification</td>
<td>1.449*</td>
<td>0.856</td>
<td>2.321**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.262)</td>
<td>(0.278)</td>
<td>(0.580)</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>--</td>
<td>1.330</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.233)</td>
<td>(0.217)</td>
<td>(0.217)</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td>39,298</td>
<td>22,847</td>
<td>39,298</td>
</tr>
<tr>
<td>All teacher cohorts</td>
<td>Obtaining certification</td>
<td>1.421**</td>
<td>1.089</td>
<td>1.523**</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.088)</td>
<td>(0.137)</td>
<td>(0.142)</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>--</td>
<td>1.242**</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.100)</td>
<td>(0.121)</td>
<td>(0.121)</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td>116,899</td>
<td>68,848</td>
<td>116,899</td>
</tr>
</tbody>
</table>

Panel B. African-American Teacher Sample‡

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Variable</th>
<th>Moved schools within district</th>
<th>Moved schools between districts</th>
<th>Left NC public schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>All teacher cohorts</td>
<td>Obtaining certification</td>
<td>1.420*</td>
<td>0.855</td>
<td>1.266</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.245)</td>
<td>(0.334)</td>
<td>(0.486)</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>--</td>
<td>1.511**</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.203)</td>
<td>(0.258)</td>
<td>(0.258)</td>
</tr>
<tr>
<td>Observations</td>
<td></td>
<td>18,008</td>
<td>10,547</td>
<td>18,008</td>
</tr>
</tbody>
</table>

*,**: Significant at 5% and 1% levels, respectively.

Note: The following variables were used in each of the models in addition to the variables reported above: teacher-level variables--gender, level of higher education, salary, license subject, licensure test scores, and differentials of teacher licensure scores against other teacher colleagues; school-level variables--locale type, proportion of minority students, proportion of students receiving free and reduced price lunch; district-level variables--expenditures-per-student and salary supplements.

‡For several of the models on African-American teachers making specific exits, too few teachers were observed making the specified move; thus failing to identify the parameters of interest. Thus, we present only the results on the aggregated model.
Table 4.
Hazard Ratios on White Teacher Mobility by Time Since NBPTS Certification

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Variable</th>
<th>Moved schools within district</th>
<th>Moved schools between districts</th>
<th>Left NC public schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>1st year after certification</td>
<td>1.373**</td>
<td>0.987</td>
<td>1.445**</td>
<td>1.951**</td>
</tr>
<tr>
<td></td>
<td>(0.112)</td>
<td>(0.146)</td>
<td>(0.185)</td>
<td>(0.429)</td>
</tr>
<tr>
<td>2nd year</td>
<td>1.495**</td>
<td>1.180</td>
<td>1.616**</td>
<td>2.465**</td>
</tr>
<tr>
<td></td>
<td>(0.141)</td>
<td>(0.216)</td>
<td>(0.239)</td>
<td>(0.659)</td>
</tr>
<tr>
<td>3rd and 4th years</td>
<td>1.417**</td>
<td>1.424</td>
<td>1.525*</td>
<td>2.674*</td>
</tr>
<tr>
<td></td>
<td>(0.152)</td>
<td>(0.368)</td>
<td>(0.267)</td>
<td>(1.116)</td>
</tr>
<tr>
<td>Applicant</td>
<td>--</td>
<td>1.242**</td>
<td>--</td>
<td>0.921</td>
</tr>
<tr>
<td></td>
<td>--</td>
<td>(0.100)</td>
<td>--</td>
<td>(0.121)</td>
</tr>
<tr>
<td>Observations</td>
<td>116,899</td>
<td>68,848</td>
<td>116,899</td>
<td>68,848</td>
</tr>
</tbody>
</table>

*,**: Significant at 5% and 1% levels, respectively.

Note: The following variables were used in each of the models in addition to the variables reported above: teacher-level variables--gender, level of higher education, salary, license subject, licensure test scores, and differentials of teacher licensure scores against other teacher colleagues; school-level variables--locale type, proportion of minority students, proportion of students receiving free & reduced lunch; district-level variables--expenditures-per-student and salary supplements. Models were estimated by stratifying at cohort level.
Table 5.
Robustness Tests on Career Mobility from NBPTS Certification

<table>
<thead>
<tr>
<th>Cohort</th>
<th>Variable</th>
<th>Moved schools within district</th>
<th>Moved schools between districts</th>
<th>Left NC public schools</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>All teacher cohorts</td>
<td>Obtaining Certification</td>
<td>1.068</td>
<td>0.870</td>
<td>1.383</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.180)</td>
<td>(0.167)</td>
<td>(0.217)</td>
</tr>
<tr>
<td></td>
<td>Applicant</td>
<td>1.434**</td>
<td>--</td>
<td>1.150</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.163)</td>
<td>--</td>
<td>(0.420)</td>
</tr>
<tr>
<td></td>
<td>Observations</td>
<td>68,848</td>
<td>6,741</td>
<td>68,848</td>
</tr>
<tr>
<td></td>
<td>Test</td>
<td>IV</td>
<td>RD</td>
<td>IV</td>
</tr>
</tbody>
</table>

*,**: Significant at 5% and 1% levels, respectively.

Note: The following variables were used in each of the models in addition to the variables reported above: teacher-level variables--gender, level of higher education, salary, license subject, licensure test scores, and differentials of teacher licensure scores against other teacher colleagues; school-level variables--locale type, proportion of minority students, proportion of students receiving free & reduced lunch; district-level variables--expenditures-per-student and salary supplements. Models were estimated by stratifying at cohort level.
Table 6.
Discontinuity Estimates for Marginal Probability of Exiting for Certified Teachers

<table>
<thead>
<tr>
<th>Exit type</th>
<th>Years after obtaining certification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year</td>
</tr>
<tr>
<td>Leaving school</td>
<td>0.078</td>
</tr>
<tr>
<td></td>
<td>(0.180)</td>
</tr>
<tr>
<td>Leaving district</td>
<td>0.147*</td>
</tr>
<tr>
<td></td>
<td>(0.280)</td>
</tr>
<tr>
<td>Leaving NC public schools</td>
<td>0.104</td>
</tr>
<tr>
<td></td>
<td>(0.334)</td>
</tr>
</tbody>
</table>

*: Significant at 5% level.
**: Significant at 1% level.

Note: Each cell represents a separate logit estimate of the marginal effect at the cutoff of passing the NBPTS exam on the likelihood of making the specified exit at increasing intervals beyond initial application.
Table 7.
Discontinuity Estimates for Nature of Transition

<table>
<thead>
<tr>
<th>Post-test comparison</th>
<th>Years after obtaining certification</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 year</td>
</tr>
<tr>
<td>Percentage of free and reduced-price lunch students</td>
<td>-0.014</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
</tr>
<tr>
<td>Percentage of minority students</td>
<td>-0.008</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
</tr>
<tr>
<td>Difference in expenditures-per-student (new - old)</td>
<td>-71.800**</td>
</tr>
<tr>
<td></td>
<td>(18.073)</td>
</tr>
</tbody>
</table>

*: **: Significant at 5% and 1% levels, respectively.

Note: Each cell represents a separate regression estimate of the impact of passing the NBPTS exam on the noted dependent variables at increasing intervals beyond initial application.
Figure 1.
Experience Distribution by NBPTS Certification Status

Panel A. Comparison of Experience Levels by Certification Status in 2004

Panel B. Comparison of Experience Levels at Initial Application by Initial Passing Status
Figure 2.
Timeline for NBPTS Application Process.

- Fall, Year t: Apply for certification
- Winter, Year t+1: Verify candidacy
- Spring, Year t+1: Submit portfolio, complete assessments
- Summer, Year t+1: NBPTS evaluates criteria, teachers arrange for next year's assignment
- Fall, Year t+1: NBPTS announces exam outcomes
- Winter, Year t+2: Those who initially fail may reapply
- Spring, Year t+2
- Summer, Year t+2: Make decision on whether to move, given NBPTS certification
- Fall, Year t+2: Teachers begin new school year
Endnotes

3. While outside the scope of this paper, NBPTS certification could have additional benefits not explicitly addressed here. For instance, if NBCTs are effective role models, their elevation in the profession might serve as a catalyst for broader positive changes in schools through role modeling or serving in a school leadership position. The rewards associated with being an NBCT may also be an incentive to those considering a career as a teacher that they can, through NBPTS, be rewarded for demonstrating key teaching skills — thus encouraging them to become teachers.
4. This perception presumably explains the significant investment in NBPTS, estimated in Goldhaber and Anthony (2007) to total more than $637 million as of 2005, with continued expansion in the years since.
5. This simple model ignores the demand side of the market. For a more comprehensive analysis of how teacher and school-district preferences interact to produce a distribution of teachers across schools, see Boyd et al. (2005) or Ballou (1996).
8. Note that this same argument could be applied to classroom assignments within schools, but sorting at the classroom level is beyond the scope of our analysis here.
9. Our ETS dataset includes all applicants who applied from North Carolina during this period, which includes applicants from all school systems (public, charter, or private). Approximately 90% of the unique teachers in this dataset were linked to those in our primary dataset from the public (non-charter) school system. A potential source of misclassification arises in the case of teachers in our data who may have applied prior to 1996-97 or who applied from another state then transferred to North Carolina. These false negatives (those considered non-applicants when they in fact applied) cannot be identified with the NBPTS dataset; however, the extent of this misclassification is likely small.
10. It is likely that the great majority of those who leave employment in North Carolina public schools also leave the teaching profession. According to the 2000-2001 Teacher Follow-up Survey, of all the teachers who left their state's public education system, only 12 percent went to teach at a different school outside the state system (Goldhaber, Gross, and Player 2007).
11. We tabulate the career transitions made by each teacher over the 1995-2001 time span, querying, “did this teacher with experience X make move type Y in this period?” The binary responses are then averaged over all teachers in each cell. Teachers could potentially make different types of moves within the time span; thus, the row percentages may sum to values greater than one. Teachers who were not observed to make any type of transition in this period are coded as staying in the same school.
12. Teachers who apply for the certification may in fact send a signal of their commitment to teaching to potential employers even before they receive the results of their assessments. They may even have a good idea of their likelihood of certification, given their known performance on the assessments. This information, however, is unobservable to us as econometricians, and to simplify we assume that a teacher’s career path is impacted only after receipt of the credential, and not prior.
13. In the survival model discussed below, we track teachers through the end of 2003. Some NBCTs (and NBPTS applicants) do transition to administration, but at a demonstrably lower rate than non-applicant teachers in general.
14. Strictly speaking, since our models have several exit types as well as the possibility of repeated exits, a repeated-event, competing-risk model would be the most appropriate estimation method. Due to computational infeasibility, however, we simulate this method by isolating each exit type and running repeated event models. This method loses some of the correlation across exit types, but we compensate for this by using robust standard errors.
15. It is, of course, arbitrary how one classifies a teacher’s career stage, but the results are not sensitive to small changes in the experience classifications (e.g., estimating the models for an early career experience category that is 4 to 10 years of experience).
16. Even comparing successful applicants against unsuccessful applicants may not be a perfect comparison, as passing may be due to differences in (unobserved) effort or motivation during the assessment process. If these unobserved
differences among applicants also determine an applicant’s outlook on future career movement, such a comparison may still be subject to bias—similar to comparisons between certified and non-certified teachers as above.

17 Hahn, Todd, and Van der Klauuw (2001) formally develop the conditions under which regression discontinuity can be employed and discuss its implications for causal testing. More recently, Porter (2003) and Lee and Card (2006) further discuss estimator choice and estimation in the presence of specification error. Angrist and Lavy (1999), Guryan (2001), and Jacob and Lefgren (2004), among others, employ analogous designs to quantify various treatment effects in empirical education contexts.

18 See www.nbpts.org for more information on the sub-assessments that go into the determination of a candidate’s overall NBPTS score.

19 A small percentage of teachers, approximately 1.5% percent, exit and then re-enter the dataset during our sample period. In the results presented below, we do not consider a teacher to move if they re-enter the dataset in the same school within a year. Our findings, however, are almost identical when we either classify these teachers as new entrants into the sample upon re-entry or exclude them from the sample altogether.

20 Results of all covariates for all move types and all experience levels are available on request. Alternate model specifications were attempted, allowing for different hazard functions between teachers by gender and school type (elementary vs. secondary); however, the hypothesis that these survival functions were proportional was not rejected, so we present the aggregated model here.

21 Relatively few districts (14%-17% in the period from 2001 to 2003) offer these financial incentives, with approximately 80% of these offering one-time bonuses only. The mean bonus and raise among schools providing them in 2003 are $722 and $937, respectively.

22 Note that these models are different in two important ways: the time span of the data and the inclusion of an application indicator. To verify that the different findings in the two columns were related to the inclusion of the omitted variable and not due to the change in time span, we estimated the first model specification using a shorter time span on our data through 2001, to match the period from the second model controlling for application. The values of the estimates showed little variation and in no case were the estimates from the shorter time span significantly different from the estimates derived from the longer time span. These results are available on request.

23 We also experimented with estimates based on stratifying at the school and district levels, which allows the baseline hazard function to vary between schools or districts while restricting the coefficients on all other variables to be equal across the state. These types of models are dynamic analogues to fixed-effects models, with fixed effects at the respective level. While we did find some distinctions between estimates in these methods and those presented here, the significance of the findings was generally unchanged. These results are available upon request.

24 Due to the time span of the data, the necessary data for NBPTS applicants in the year 2000 are not available four years after certification. Accordingly, the estimates in the last column only include applicants in 1997-1999.

25 A potential weakness to the regression discontinuity design employed here is that coefficient estimates may be sensitive to the model specification used. To check the robustness of our findings, we estimate the discontinuity of all models presented in this section on a first- through fourth-order polynomial expansion on the test score. The results presented in these tables are those determined to be the best fit, using tests of goodness of fit. Our findings on all these model specifications suggest that the significant coefficients are generally robust to the model.

26 Smoothness checks performed on pre-existing variables indicating teachers’ teaching assignments using polynomial expansions of test performance supported this underlying assumption of the model, except in the case of African-American and white NBPTS applicants, which gave us reason to be suspicious of discontinuous performance on the exam. Due to this discontinuity, we remove non-white applicants from these models.

27 To mitigate the effects of inflation, we measure the difference in expenditures-per-student from the initial application year to the year of observation and employ these as the dependent variables in our analysis.

28 While there is a high correlation between the percentage of minority students in a school and various measures of disadvantage, such as the percentage of free and reduced-price lunch eligible students, our findings suggest that such targeting may not address all equity concerns since teachers appear, again consistent with recent research, to be more concerned about the racial/ethnic make-up of a school’s student body than about its socioeconomic make-up (Stinebrickner, Scafidi, and Sjoquist 2005).

29 The distribution of NBCTs in Los Angeles Unified School District appears to explain much of the differential distribution in California as a whole.