NATIONAL BOARD CERTIFICATION AND TEACHERS' CAREER PATHS: DOES NBPTS CERTIFICATION INFLUENCE HOW LONG TEACHERS REMAIN IN THE PROFESSION AND WHERE THEY TEACH?

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Abstract

Investment in the certification of teachers by the National Board of Professional Teaching Standards (NBPTS) represents a significant policy initiative for the nation's public school teachers. This article investigates the potential impact of NBPTS certification on teachers' career paths. Using a competing risks model on data from North Carolina public schools, we find evidence that those teachers who apply to NBPTS are more likely to be mobile than are nonapplicants, particularly after they have gone through the certification process. Regression discontinuity estimates suggest that National Board–certified teachers are more likely than unsuccessful applicants to leave the North Carolina public school system and that this appears to result from certified teachers exiting high-minority schools, particularly Charlotte-Mecklenburg schools.

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1. WHY MIGHT NBPTS CERTIFICATION AFFECT A TEACHER'S CAREER PATH?

The movement to professionalize teaching embodied by the National Board for Professional Teaching Standards (NBPTS) is arguably one of the most significant teacher policy initiatives of the last three decades. NBPTS's expansion and popularity among the profession have been facilitated by state and local financial incentives for NBPTS certification and through the No Child Left Behind Act, 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 73,400.[1] An important aspect of this program that has not previously been analyzed is how NBPTS might affect the career paths of teachers who obtain this certificate.

Empirical evidence suggests that teacher quality can have a profound impact on student achievement (Hanushek 1992; Rockoff 2004; Rivkin, Hanushek, and Kain 2005) and that, when judged by any number of qualifications, teachers tend to be inequitably distributed across schools and students. Many teachers who leave the profession are the very ones we might wish to keep, at least as judged by their performance on licensure tests (or other tests, such as the SAT) and the selectivity of the colleges from which they graduated.[2] Thus, 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 National Board–certified teachers (NBCTs).

The rewards or recognition that come with being an NBCT may influence high-quality teachers to stay in the teaching profession longer than they otherwise would.[3] But regardless of their actual impact, there is certainly the *perception* that NBCTs represent a valuable educational resource, and this in itself is likely to affect teachers' career decisions.[4] And it is these career path decisions that implicitly determine the distribution of teachers across students. The distribution of NBCTs is of interest not only from a teacher quality

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1. As of 2008 (see www.nbpts.org/resources/nbct_directory/nbcts_by_year).
2. See, for instance, Lankford, Loeb, and Wyckoff (2002) on the distribution of teachers across schools and students, and Murnane and Olsen (1990) or Podgursky, Monroe, and Watson (2004) on the characteristics of teachers who leave the profession.
3. Some (e.g., Cavalluzzo 2004; Cantrell et al. 2008; Clotfelter, Ladd, and Vigdor 2007; Goldhaber and Anthony 2007; Vandevoort, Amrein-Beardsley, and Berliner 2004) but not all (Harris and Sass 2008; Sanders, Ashton, and Wright 2005) empirical evidence suggests that NBCTs are more effective in their classrooms than noncertified teachers.
4. This perception presumably explains the significant investment in NBPTS, estimated by Goldhaber and Anthony (2007) to total more than $637 million as of 2005, with continued expansion in the years since.

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 (which was $2,500 in 2008) 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, the state we focus on in this study, North Carolina, pays the full cost of the NBPTS assessment and provides NBCTs with a 12 percent 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 article, we use competing risks and regression discontinuity models to examine how obtaining NBPTS certification affects public school teachers' career mobility in North Carolina. Like a number of other states, North Carolina pays a salary supplement to teachers who become NBPTS certified, so it is important to note that the career path effects we identify are not strictly associated with certification but are the combined effect of certification and the salary supplement.

We find that those teachers who apply to NBPTS are more likely to be mobile than nonapplicants, particularly after they have gone through the certification process. Regression discontinuity estimates suggest that NBCTs are more likely than unsuccessful applicants to leave the North Carolina public school system and that this appears to result from NBCTs exiting high-minority schools, particularly Charlotte-Mecklenburg schools. Finally, we observe evidence consistent with NBCTs sorting into more favorable (measured by student characteristics and per pupil expenditures) teaching assignments.[5]

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 3 we discuss the data and empirical methods used to test our model, and in section 4 we present our findings. In the final section we focus on the policy implications of the results and offer some concluding thoughts.

2. 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. This is often referred to as a teaching certificate, but it is distinct from certification by the National Board for Professional Teaching Standards.

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5. For an expanded, more detailed version of this article, see Goldhaber and Hansen (2008).

The NBPTS certificate is awarded to professionals who can show mastery of specific teaching skills (the assessment process will be described in greater detail below) but is not required to participate in the labor market. Theory would suggest that the receipt of this advanced credential would have career path impacts. For example, there are benefits associated with the receipt of the NBPTS credential, and 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.

Assume a simple model of job choice where job transitions are costless and individual i chooses among various jobs, j, in order to maximize the present value of expected utility:[6]

$$\max_j \ pv[u^i(T_j, X_i)], \quad given \ j \in \{j\}_i. \tag{1}$$

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 nonpecuniary job factors, N_j:

$$T_j = f(C_j, N_j). \tag{2}$$

Individual i will opt to pursue a teaching career if the utility associated with the best teaching job exceeds that of the best nonteaching job:

$$\max_{j \in school} \ pv[u^i(T_j, X_i)] > \max_{j \notin school} \ pv[u^i(T_j, X_i)]. \tag{3}$$

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).[7] Empirical evidence suggests that the relative financial rewards and job opportunities in and outside teaching influence both teacher quit rates and the length of time that teachers stay in the profession.[8] However, even in the absence of financial incentives, we might expect NBPTS certification to make teaching more attractive, through nonpecuniary

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6. 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).

7. As of the 2006–7 school year, thirty-four states and the District of Columbia provided some type of financial compensation for NBCTs (data collected from NBPTS, State and Local Information, www.nbpts.org/resources/state_local_information).

8. See Baugh and Stone (1982), Brewer (1996), Dolton and van der Klaauw (1999), Greenberg and McCall (1974), Murnane (1981), Murnane and Olsen (1989), and Stinebrickner, Scafidi, and Sjoquist (2007). Also, some empirical evidence suggests that NBPTS certification could affect the quit rates of noncertified teachers by providing potential avenues for teacher career advancement (Brewer 1996).

job factors (N_j), 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).

All this 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. We stress, however, that we are assessing the impact of the NBPTS credential in a particular institutional context. In the case we analyze—North Carolina—the estimated "NBPTS effect" is not merely the impact of the credential but is a combined effect of the credential and the 12 percent salary supplement. In light of this, there are at least three reasons why it may not keep NBCTs in the North Carolina teaching workforce longer.

First, the NBPTS certification is widely recognized and has, de facto, become a national teaching credential. So being an NBCT carries benefits outside North Carolina in addition to those offered in the state. Many states automatically grant licensure to those who are NBCTs, so some individuals may be obtaining the NBPTS credential in order to enhance their employment options in other states. For example, it would not be surprising if some NBCTs, minted in North Carolina, opted for employment across the border in South Carolina where the annual bonus for being an NBCT can actually be larger, depending on a teacher's position on the single salary schedule (since 2002, NBCTs in South Carolina have received a $7,500 salary supplement; for state-specific information on incentives and licensure see www.nbpts.org/resources/state_local_information). In the following section, we attempt to account for cross-state mobility by focusing special attention on teachers who are most likely to make out-of-state (hence out of our sample) moves.

Second, while we might expect NBCTs to stay in the teaching profession longer, the credential may not keep them in their role as classroom teachers longer. Teachers in North Carolina who move out of their role of classroom teacher lose the added NBPTS-associated compensation, discouraging them from moving to a nonclassroom position. 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. Thus one of the types of moves we explore is into a nonteaching position in the North Carolina school system.

Finally, in North Carolina the NBCT salary supplement is pensionable, meaning that the supplement can figure into a teacher's retirement benefit. It is therefore conceivable that the additional salary that NBCTs can receive as a consequence of the supplement could induce earlier retirement, shortening

the period of time, post certification, that a teacher remains in the North Carolina school system. We attempt to account for this (described below) by estimating models for teachers of various experience levels separately and controlling for retirement eligibility in some specifications.

Predicting the effects of NBPTS status on teacher distribution across schools is more straightforward, at least in terms of how teacher preferences are likely to influence this distribution. While it is a stated goal of NBPTS to "contribute to the equitable distribution of resources by making the placement of accomplished teachers a more overt process" (Baratz-Snowden 1990, p. 24), 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 2007). When controlling for degree and experience levels, teacher salaries do not vary much within school districts (and sometimes within states), while the nonpecuniary 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 would optimize their nonpecuniary compensation by choosing to work in more advantaged schools.[9]

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 teachers 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 percent salary supplement. In addition, 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 a school's control, we do not offer a hypothesis for the effect the NBPTS credential has on the length of time 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,

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9. 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.

given teachers' preferences, state and district policies may enable teachers to move in such a way as to exacerbate inequalities in the school system.

3. DATA AND EMPIRICAL METHODS

The primary data for this study are 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 demographic and employment information for over 70,000 teachers per year covering a ten-year period (covering school years 1994–95 though 2003–4). A subset of the teacher records can be matched with data from the Educational Testing Service (ETS) that include information on which teachers applied to, and were certified by, NBPTS during the period 1997–2000. All 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 nonmonetary, 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 percent salary supplement to teachers who obtain NBPTS certification. Not surprisingly, given these incentives (which are among the most generous in the nation), at the time of this writing North Carolina has the most NBCTs of any state in the country. More important, the North Carolina data permit 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.

We restrict our sample to full-time white teachers who have taught for at least three years and fewer than thirty years. We opt for these restrictions because the sample of minority teachers was quite small, teachers with fewer 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.[10] This yields a sample of 491,974 teacher observations consisting of 93,307 unique teachers. We identify a teacher as an NBCT from an indication on the teacher's payroll records showing that she or he received the state's 12 percent salary supplement. Our sample contains a total of 14,915 NBCT observations and 5,565 unique NBCTs (identified through this method). Panel A of table 1

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10. In Goldhaber and Hansen (2008), we report some findings for African American teachers, but the small sample size of African American teachers greatly limits the power to detect meaningful findings from this sample. This is an important limitation because some research (e.g., Jackson 2008) suggests that the mobility behavior of white and African American teachers may be different.

Table 1. Descriptive Statistics of Data and Mobility

Panel A. Means and Standard Deviations of Teachers in 2003–4 Academic Year by NBCT Status

	Individual variables			School variables			District variables (U.S.$)		
	Female	Graduate degree holder	Average licensure test score[a]	Proportion of minority students	Proportion of free lunch students		Median housing value	Expenditures per student	Total
Noncertified teachers	0.789 (0.41)	0.295 (0.46)	0.125 (0.84)	0.371 (0.24)	0.349 (0.19)		99,496 (27,366)	4,125 (363)	48,033
NBCTs	0.890 (0.31)	0.507 (0.50)	0.409 (0.74)	0.342 (0.22)	0.308 (0.17)		104,715 (30,449)	4,170 (410)	4,845

Note: Observations are unique teachers appearing in the data set, using payroll status to identify NBCTs.
[a]Teachers' scores for various licensure tests are standardized against the test distribution, resulting in a single z-score for each teacher. Where the same teacher has taken multiple tests, z-scores are averaged together.

Panel B. Observed Teacher Transitions through 2001 by NBPTS Application Status							
Experience level	Certification status	Stayed in same school	Switched schools	Switched districts	Left NC public schools	Switched to administration	Total
3–11 years	Nonapplicant	43.8%	18.7%	10.0%	34.9%	0.3%	40,397
	Applicant	51.8%	29.3%	14.6%	12.3%	0.1%	1,592
	NBCT	45.3%	32.8%	16.3%	14.8%	0.3%	786
12–20 years	Nonapplicant	58.2%	17.3%	6.4%	22.7%	0.4%	28,301
	Applicant	67.8%	20.1%	7.0%	8.2%	0.0%	1,225
	NBCT	63.8%	23.6%	6.3%	9.8%	0.0%	569
Over 20 years	Nonapplicant	52.6%	14.3%	3.9%	33.4%	0.4%	23,509
	Applicant	69.0%	18.2%	5.0%	10.7%	0.0%	758
	NBCT	69.2%	18.9%	4.7%	9.8%	0.0%	509

Notes: Observations are unique teachers appearing in the data set through the 2000–1 school year meeting the specified experience and certification criteria, using linked ETS data to identify application status. Certified teachers are a subset of exam applicants.

reports sample statistics for select variables by NBPTS status for all teachers observed during 2003–4, the last school year included in the analysis.

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 are significantly less likely to be African American (Goldhaber, Perry, and Anthony 2004). 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 data set (those who appear in the data between the years 1997 and 2000), we have supplementary data from ETS that provide information on teachers who applied to NBPTS, including the scores each applicant received on the ten sub-assessments that comprise the certification process. This information allows us to compare successful and unsuccessful applicants to NBPTS and to investigate applicant career paths along the continuum of performance on the NBPTS assessments. Within this ETS data set, we successfully link 2,580 unique NBPTS applicants to our primary data, of whom 1,385 passed on the initial attempt and an additional 294 passed on successive attempts within the four-year time span of the data.[11] Additional information pertaining to NBPTS certification is detailed in Goldhaber and Hansen (2008), including particulars of the application process.

Panel B of table 1 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),[12] and (5) moving from a teaching position into an administrative position. The data are categorized by experience level and into three groups: those who never apply for certification, those who apply for certification,[13] and those who apply for certification and successfully

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11. Our ETS data set includes all applicants from all school systems (public, charter, or private) who applied from North Carolina during this period. Approximately 90 percent of the unique teachers in this data set were linked to those in our primary data set from the public (noncharter) 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 and then transferred to North Carolina. These false negatives (those considered nonapplicants when they in fact applied) cannot be identified with the NBPTS data set; however, the extent of this misclassification is likely small.

12. 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 2000–1 *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).

13. We classify teachers as applicants here if they apply *at any point* during the sample period because teachers who ultimately apply to NBPTS may be different from nonapplicant teachers even before they actually opt to apply. Teachers are classified as NBCTs in the year in which they are publicly

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.[14]

Several noteworthy patterns emerge from a casual examination of panel B. First, NBPTS applicants at all experience levels appear to be less likely than nonapplicants to leave their own schools and far less likely to leave the North Carolina public school system (the differences between groups are statistically significant). For example, 68 percent of NBPTS applicant teachers with 12–20 years of experience remained in the same school over the period versus about 58 percent of nonapplicants. Second, when applicant teachers do move, they tend to do so within the school system (school and district moves), whereas nonapplicants tend to move out of the state system altogether. Third, while applicants in general are more likely than nonapplicants 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 percent) of teachers in general are observed to move to an administrative position in either the school or the district, and in our sample only two of the NBPTS applicants were observed making this type of career move. This is somewhat surprising because surveys of NBCTs suggest that career progression is one factor in the decision to seek NBPTS certification (Kelley and Kimball 2001). Though it is certainly possible that once certified, a teacher may opt to teach for a few years before moving into an administrative post, longer-term observations of the teachers in our sample (beyond the 2000–1 school year reported here) do not suggest that NBCTs are more likely than other teachers to move into administrative posts and even suggest that they may be less likely to make such a move.[15] A noteworthy aspect of such a transition is that a certified teacher would forgo the 12 percent teacher salary supplement by moving into an administrative position because 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.

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recognized as being NBPTS certified because the credential does not likely affect a teacher's career path directly until it has been officially bestowed upon her.

14. We tabulate the career transitions made by each teacher over the 1995–2001 time span, asking, "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.

15. 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 nonapplicant teachers in general.

Given the small number of NBCTs who move into administration, we cannot make any inferences about this transition and thus omit this type of exit from the remainder of our analysis.

Competing Risks Hazard Models

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:[16]

$$h_j(t \mid X, T, \text{NBC status}) = k_j(t) \exp(X_t\beta_1 + T_t\beta_2 + D^{NBCT}\beta_3) \tag{4}$$

for $j \in$ (school exit, district exit, and NC state public school system).

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. This effect is detected through the estimated coefficient on the NBCT indicator variable (β_3). Straightforward estimation of this model, however, can only be descriptive because NBCTs may have unobservable characteristics that influence both their likelihood of obtaining certification and their future career mobility.[17]

To begin to see whether it is the NBPTS credential, as opposed to the attributes of those teachers who obtain this credential, that influences teacher career paths, we estimate additional competing risks models that include controls for a teacher's application status.[18] This is a variant of equation 4 above where, in place of the NBCT indicator, we substitute a vector of indicators on a teacher's application and certification status. This vector has indicators for

16. Strictly speaking, since our models have several exit types as well as the possibility of repeated exits, a repeated event competing risks 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.

17. In Goldhaber and Hansen (2008), we present the results of this model where we control only for NBCT status but omit it here for brevity. The estimates are consistent with the mobility reported in panel B of table 1.

18. As mentioned above, we have detailed NBPTS application and assessment score 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).

preapplication, reapplication (if applicable), post failure, and post certification, as outlined in equation 5:[19]

$$h_j(t \mid X, T, \text{NBC status}) = k_j(t) \exp(X_t\beta_1 + T_t\beta_2 + D^{\text{Applicant}}\beta_3$$

$$+ D^{\text{Reapplicant}}\beta_5 + D^{\text{Unsuccessful Applicant}}\beta_6 + D^{\text{NBCT}}\beta_7)$$

$$\textit{for } j \in (\textit{school exit, district exit, and state exit}). \quad (5)$$

Because all applicants demonstrate a similar motivation to put forth at least a minimal cost of time and effort to complete the examination process, the comparison between successful and unsuccessful *applicants* is at least as good as the original comparison, and likely better.[20] Teachers classified as "Applicants" are those teachers in the sample who apply to NBPTS at some point in the years of our data, and they are only applicants prior to the announcement of their initial assessment results. If successful, applicants are reclassified (in each year) as either an "NBCT" if successful; an "Unsuccessful Applicant" if unsuccessful; or a "Reapplicant" if they are unsuccessful but reapply to NBPTS. Each of these categories is mutually exclusive, and the omitted category consists of teachers who do not apply to NBPTS during the period for which we have data on applicants.[21]

We recognize that receiving NBPTS certification likely affects teachers differently depending on the stage of their career (recall, for instance, that teachers close to retirement may try to become NBPTS certified in order to increase their retirement benefits). Accordingly, we employ this competing risks model with three distinct experience classes: (1) teachers who have completed

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19. This specification could be considered a modified difference-in-differences (DID) approach within the competing risks model. An unrestrictive DID model in this case would have indicators on being either a successful, unsuccessful, or successful-with-retake applicant and timing indicators on the preapplication, reapplication, and post-results periods. We implemented this model in our data, but the $3 \times 3 = 9$ categorical variables were not always fully identified in each model specification. Where identified, Wald tests on this unrestrictive model supported the assumptions embedded within equation 5. Imposing these assumptions combined the nine categorical variables into four, increasing power, simplifying the results, and enabling all effects to be identified in most models.

20. Even comparing successful applicants against unsuccessful applicants may not be a perfect comparison because 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 noncertified teachers as above.

21. Since data on NBPTS applications are available only for a subset of the overall time span, we restrict the analysis for this sample through the 2000–1 school year, the last year that we can confidently assert moves for these applicants without introducing other unknown applicants. Note that we use this abbreviated time span when comparing applicants with nonapplicants, and we do so in order to not misclassify teachers who apply to NBPTS after 2000 (the end of our ETS data). When making comparisons within the group of known applicants only, as in the regression discontinuity models, we use all data through 2003 to incorporate all the data available to us.

3–11 years of teaching, (2) teachers who have completed 12–20 years of teaching, and (3) teachers who have completed 21–29 years of teaching.[22] In this model, entrance into the study occurs when a teacher meets the lower experience limit of a cohort; thus a baseline hazard function for each cohort of teachers implicitly holds experience levels constant. Specifying the model in this way allows for heterogeneous influence at different points along a teacher's career and is the best feasible approach in light of the left-censoring problem that arises from our inability to observe each teacher's moment of entry into the North Carolina system. Thus the findings presented here are all conditional on attaining the specified level of experience. We observe teacher mobility by comparing changes from one year to the next, giving an effective eight-year span of observations for teachers entering the study in 1995.

This model is likely more informative about the impact of the NBCT credential than that in equation 4, which focuses only on whether or not a teacher is an NBCT. However, for at least two reasons, it is still appropriate to be cautious about interpreting the coefficient estimates as causal. First, the indicator variable on Applicant is forward looking in identifying all who apply sometime in the 1997–2000 range; since one of our outcomes of interest (leaving the state system) by definition excludes future observations for an exiting teacher, the estimate will be biased downward in the specification for leaving the state.[23] Second, while we hope the comparison of successful and unsuccessful NBPTS applicants is likely to mitigate some of the selection bias arising from unobservables that are correlated both with teachers' career paths and their NBPTS status, we still worry about unobserved differences between those teachers who attempt NBPTS certification and are successful and those who also attempt to be certified but do not successfully attain the NBPTS credential.[24]

Regression Discontinuity Models

In a further attempt to address the potential that unobserved differences between successful and unsuccessful applicants might bias our estimates of an NBPTS impact, we employ a regression discontinuity (RD) estimation

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22. 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 four to ten years of experience). The upper limit in each of these cohorts is not explicit but rather implied by the eight-year time span of our data. The experience levels establishing entry into the study are intentionally spaced to ensure that each unique teacher in our data contributes no more than one observation.
23. Identification of this and the Reapplicant variable is based on a relatively small number of teachers who leave the system in the year in which they apply (or reapply) to NBPTS.
24. In theory one might address this issue by estimating teacher fixed effects models, but in practice there are too few cases in which we observe variation in the outcome of interest (e.g., repeated moves).

approach.[25] The RD 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 that may be unobservable to the econometrician.

Both theory and research suggest that important information about teachers is conveyed by their NBPTS assessment score (Goldhaber and Anthony 2007), but an applicant's precise final score 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.[26] In the framework of the NBPTS exam, applicants are evaluated on ten different sub-assessments; the summative score of these (plus a constant) ranges from 87 to 437, but only those teachers whose scores are 275 and over pass. This sharp cutoff forms the basis for comparison in the RD analysis. Assuming that assignment to passing status can be considered a random event around the cutoff point, we can utilize the quasi-experimental RD design to determine an average treatment effect, which is the effect on teachers' careers of passing the exam, estimated with the following model:

$$y = S\beta_1 + S \cdot I_{(Pass)}\beta_2 + I_{(Pass)}\beta_3 \tag{6}$$

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 ($S \cdot I_{(Pass)}$), 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 (β_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 consider only the first attempt of each applicant and exclude any exam retakes because 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 on which they did poorly, we expect outcomes for retakes

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25. Hahn, Todd, and van der Klaauw (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.

26. This is particularly true because some of the sub-assessments are based on subjective assessments of applicants. See www.nbpts.org for more information on the sub-assessments that go into the determination of a candidate's overall NBPTS score.

to be less random than those for initial attempts.[27] 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.

We use an RD approach for three different purposes. First, we use RD to perform robustness checks on the competing risks model, in which we estimate the model among applicants only and include a quartic expansion of an applicant's initial assessment score as a control. Second, we test the likelihood of both successful and unsuccessful applicants making a specified career move within a certain window following application to NBPTS. Finally, we use RD to analyze differences in the types of teaching assignments certified teachers obtain vis-à-vis their unsuccessful counterparts.

In these latter two applications, we consider exit decisions made at increasing intervals after becoming certified because 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. The estimates based on the shorter time horizons 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 after the receipt of the credential. The longer-term estimates can capture more of the *total* impact of NBPTS certification on teacher transitions over time, but error is introduced into the control group, biasing the magnitude of the difference toward zero.[28] These two effects alone would lead us to conclude that the results are likely a lower bound. But we must also consider the potential impact of nontreatment (i.e., not being NBPTS certified) on applicants; failing the exam itself may also change teachers' career paths. Teachers who plan a second attempt at certification, for example, may see benefits to remaining in their current school while going through the assessment a second time. As a result, a comparison of the treatment group's behavior against the now-affected control group has the potential to either overstate or understate the magnitude of the treatment effect on the treated, depending on the effect on the nontreated. We address this issue further in section 4.

27. In our data, 54 percent of initial applicants passed on their first attempt; of those who fail, we observe that 49 percent reapply (usually the following year), and roughly half of these are successful on their second attempt.

28. Opening this window of movement to multiple years beyond certification introduces a bias into our control group (those who initially failed) by including those who later reapplied and passed. 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 independent of the number of attempts). This bias will not exist in the first year after certification but may increase with time as teachers reapply.

4. RESULTS

Estimates from the Competing Risks Model

We present the results of the competing risks models for the variables of interest in table 2. The findings are reported for teachers in each experience cohort separately, and combined results (stratified by cohort) are presented in the final three columns.[29] We separately report the effect of NBPTS status on a move from one school to another within a district (labeled "school exit"), the effect of a move from one school to another between districts ("district exit"), and the effect of a move out of the North Carolina public school system ("NC exit").

We begin by inspecting those columns reporting the hazard ratios for moves within the state school system (school and district exits).[30] Here we see evidence, in some cases significant, that virtually all teachers associated with NBPTS show increased teacher mobility between assignments within the state compared with nonapplicants. With the exception of the Applicant estimates in the district exit columns, all the point estimates for the NBPTS variables are greater than one. Also, across experience groups, we observe that successfully certified teachers (the NBCT estimate) appear to be more likely (in some cases far more likely) to move within the state than nonapplicants. But a comparison of the NBCT hazard ratios with those on Unsuccessful Applicant shows little difference in within-state mobility patterns (in no case is the difference between these two statistically significant), suggesting that the NBPTS credential itself does not change the within-state movement of teachers.

The hazard ratios for exiting the North Carolina public school system, by contrast, suggest that Applicants and Reapplicants make this type of exit much less frequently than those teachers not associated with the NBPTS process at all (i.e., nonapplicants during our sample period). This finding is not surprising, given that teachers choosing to expend the effort to apply are likely committed to the profession long term; also, recall that the forward-looking nature of the

29. A small percentage of teachers, approximately 1.5 percent, exit and then re-enter the data set during our sample period. In the results presented below, we do not consider a teacher to exit if they re-enter the data set in the same school within a year. The inclusion of these observations made no distinguishable difference in the results.

30. It is worth noting that our findings on other variables are largely consistent with the extant literature. For example, we find 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. 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). In addition, we note that model specifications allowing for different hazard functions between teachers by gender and school type (elementary versus secondary) were attempted; however, the hypothesis that these survival functions were proportional was not rejected, so we present the aggregated model here.

Table 2. Estimated Hazard Ratio Impacts for NBPTS Application and Certification, 1995–2001

Variable	3–11 Years of Experience			12–20 Years of Experience			21–29 Years of Experience			All Teacher Cohorts		
	School exit	District exit	NC exit	School exit	District exit	NC exit	School exit	District exit	NC exit	School exit	District exit	NC exit
Applicant	1.265* (0.12)	0.977 (0.13)	0.099** (0.02)	1.226 (0.21)	0.755 (0.27)	0.196** (0.07)	1.259 (0.22)	0.551 (0.25)	0.330** (0.08)	1.254** (0.10)	0.885 (0.11)	0.154** (0.02)
Reapplicant	1.002 (0.31)	1.454 (0.50)	0.463* (0.17)	1.446 (0.60)	1.272 (0.88)	0.664 (0.38)	1.014 (0.49)	–	0.757 (0.37)	1.122 (0.25)	1.236 (0.38)	0.572* (0.15)
Unsuccessful applicant	1.267 (0.23)	1.266 (0.32)	0.690 (0.14)	1.454 (0.36)	1.358 (0.59)	0.997 (0.31)	1.079 (0.33)	1.698 (0.84)	0.427 (0.19)	1.304* (0.17)	1.334 (0.27)	0.694* (0.11)
NBCT	1.416** (0.19)	1.682** (0.31)	1.000 (0.12)	1.751** (0.32)	1.208 (0.45)	0.930 (0.21)	1.139 (0.27)	2.928** (0.86)	0.774 (0.19)	1.463** (0.14)	1.641** (0.24)	0.895 (0.09)
	Omitted group in each model is nonapplicant to NBPTS											
Observations	36,404	36,404	36,404	26,395	26,395	26,395	31,955	31,955	31,955	94,709	94,709	94,709

Notes: Robust standard errors in parentheses. Analysis sample comprised white teachers only. Indicators of application and certification are created from ETS data set covering all NBPTS applicants from North Carolina, 1997–2000. 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—indicators on location within a county bordering another state, expenditures per student, and salary supplements.
*significant at 5%; **significant at 1%.

Applicant estimate gives us reason to believe this is biased downward. Teachers who initially fail but reapply seem to exit more than they did during the application phase (the difference between these two periods is significant only in the early career cohort) but generally still less than the baseline population. One might guess that NBCTs would also be more likely to remain in the system for the same reason; however, this turns out not to be the case because they do not have a higher likelihood of staying than nonapplicants (the differences between Unsuccessful Applicant and NBCT estimates are only marginally significant).[31] In fact, compared with their behavior prior to applying (where they demonstrate a significantly lower likelihood of exiting), the increase in risk for exiting the state due to obtaining certification is substantial.[32]

In sum, the comparison among NBPTS applicants, NBCTs, and nonapplicant teachers suggests that NBCTs are more likely (in some cases far more likely) to move within the state than nonapplicants, but NBPTS certification itself does not appear to change the within-state movement of teachers: the probability of leaving a school district is similar for those who become NBCTs and those who attempt certification but fail. Not surprisingly, Applicants and Reapplicants exit the state/system much less frequently than teachers who are not associated with the NBPTS process at all, but once certified, NBCTs are no more likely than other nonapplicant teachers to stay in the system and are substantially *less* likely to stay relative to their preapplication behavior.

Regression Discontinuity Approach

To address the possibility that unobserved teacher characteristics might be correlated with NBPTS status and career transitions, we estimate the competing risks model using a regression discontinuity style approach. The motivation behind this approach is that the actual score of applicants provides more information than a simple binary pass-fail indicator, and using it as a control removes pre-existing, though unobservable, tendencies for career movement among applicants.[33] To estimate this model, we focus exclusively on the applicants in our data and test for mobility differences that may arise from certification, holding initial certification assessment score constant. The results from these models are presented in table 3.

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31. We also experimented with estimates based on stratifying at the school and district levels—these are dynamic analogues to fixed effects models. While we did find some distinctions between estimates in these additional methods and those presented here, the significance of the findings was generally unchanged. These results are available upon request.

32. We attempt to add precision to these estimates by presenting (in the final three columns) the results on aggregated models containing all cohorts simultaneously (stratifying by cohort); estimates from these models were generally consistent with those presented above.

33. By assumption, the continuity of outcomes for teachers on either side of the cutoff ensures that this approach is valid. Smoothness checks performed on pre-existing variables among applicants

Table 3. Estimated Career Path Using Regression Discontinuity Approach among NBPTS Applicants Only, 1995–2003

	Variable	School Exit	District Exit	NC Exit
All teacher cohorts, stratified	Reapplicant	0.990 (0.28)	1.615 (0.70)	1.898 (0.75)
	Unsuccessful applicant	1.353 (0.32)	1.295 (0.57)	2.272* (0.75)
	NBCT	0.874 (0.22)	1.293 (0.55)	2.748** (0.92)
	Omitted group in each model is NBPTS applicants			
	Observations	6,745	6,745	6,745

Notes: Robust standard errors in parentheses. Analysis sample comprised white teachers only. Indicators of application and certification are created from ETS data set covering all NBPTS applicants from North Carolina, 1997–2000. 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, differentials of teacher licensure scores against other teacher colleagues, and a quartic expansion of the NBPTS assessment score; school-level variables—locale type, proportion of minority students, proportion of students receiving free and reduced price lunch; district-level variables—indicators on location within a county bordering another state, expenditures per student, and salary supplements.
*significant at 5%; **significant at 1%.

The hazard ratio estimates on within-district moves are not significantly different from the baseline hazard (composed of NPBTS applicants up through their initial application); those on district exits are all insignificant as well, though positive and somewhat sizable. A mobility impact may be present, but it is undetectable here because of low power. In the case of leaving the school system altogether, the estimates are all large and significant for those not reapplying. The estimate on NBCT is a good deal larger than that on Unsuccessful Applicant, though the difference between the two is not significant. As in the findings reported above, we see reason to believe that NBCTs are not retained within the state and that the certification may actually increase their propensity to move; however, the estimates in table 3 show that all teachers associated with the NBPTS process are more mobile after initially applying, so whether this mobility is due solely to becoming certified is not entirely clear from the evidence presented here.

To further test the possibility that NBCTs are in fact more mobile than non-NBCTs and that this is not attributable to unobservable characteristics that may be associated with applying for NBPTS certification, we turn to a traditional regression discontinuity approach. As above, we restrict the analyses to the sample of NBPTS applicants only. In table 4 we report our findings for

supported this underlying assumption, except in the case of African American and white NBPTS applicants, as noted previously (see note 10).

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Table 4. Regression Discontinuity Estimates on Exiting among NBPTS Applicants, 1995–2003

Panel A. School Exits								
	1 year after initial assessment		**2 years after initial assessment**		**3 years after initial assessment**		**4 years after initial assessment**	
NBCT	1.419 (0.30)	0.987 (0.27)	1.259 (0.29)	0.983 (0.26)	1.498** (0.29)	1.438 (0.32)	1.661** (0.38)	1.715** (0.44)
Percentage of minority students	– –	0.930 (0.37)	– –	1.357 (0.41)	– –	1.702** (0.43)	– –	2.068** (0.60)
Percentage of minority students × NBCT	– –	2.997** (1.63)	– –	2.111* (0.94)	– –	1.134 (0.47)	– –	0.910 (0.44)
Observations	2,521		2,521		2,521		1,444	

Panel B. District Exits								
	1 year after initial assessment		**2 years after initial assessment**		**3 years after initial assessment**		**4 years after initial assessment**	
NBCT	1.891* (0.65)	1.476 (0.62)	1.819** (0.49)	1.407 (0.48)	1.866*** (0.43)	1.667* (0.47)	1.853** (0.51)	1.347 (0.43)
Percentage of minority students	– –	1.177 (0.66)	– –	1.382 (0.67)	– –	1.664 (0.56)	– –	1.264 (0.47)
Percentage of minority students × NBCT	– –	2.092 (1.44)	– –	2.149 (1.21)	– –	1.410 (0.62)	– –	2.784* (1.53)
Observations	2,521		2,521		2,521		1,444	

Panel C. North Carolina Exits								
	1 year after initial assessment		**2 years after initial assessment**		**3 years after initial assessment**		**4 years after initial assessment**	
NBCT	1.519 (0.51)	1.006 (0.46)	1.844*** (0.42)	1.221 (0.40)	1.839*** (0.40)	1.327 (0.38)	1.489 (0.40)	0.943 (0.31)
Percentage of minority students	– –	1.367 (0.94)	– –	1.236 (0.72)	– –	1.196 (0.55)	– –	0.695 (0.31)
Percentage of minority students × NBCT	– –	3.216 (2.75)	– –	3.353* (2.30)	– –	2.671* (1.44)	– –	4.399** (2.70)
Observations	2,521		2,521		2,521		1,444	

Notes: Robust standard errors in parentheses. Reported estimates are odds ratios under separate logit models on the likelihood of making the specified exit within the specified time after becoming certified. All explanatory variables are those observed in the teacher at the time of initial application to the NBPTS assessment. All models also include a quadratic expansion on initial assessment score.
*significant at 10%; **significant at 5%; ***significant at 1%.

models identifying a teacher's probability of exiting a given assignment within a specified time period after obtaining NBPTS certification (one, two, three, or four years).[34]

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34. 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 include only applicants in 1997–99.

In table 4, we categorize exit types interdependently (as opposed to the competing risks models reported in tables 2 and 3, 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 exit in concert with other exit types and thus incorporates more information into the estimates. Since the regression discontinuity methods look at each specific exit in isolation, we are compelled to analyze the moves in this less informative approach and not make distinctions among exit types that were possible in the competing risks analysis. Because these moves are nested, however, school moves are essentially weighted averages of making school (within-district), district (within-state), and state exits; likewise, district moves reflect district (within-state) and state exits.

These models are based on a quadratic 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).[35] Under each year heading, the results from two models are reported: the first controls for being an NBCT, the second has additional controls on working conditions (this second model is discussed below). The NBCT estimate is an odds ratio derived from the estimate of β_3 from equation 6 above, where the dependent variable of interest for each model is a binary indicator representing whether an applicant made the specified move within the given time period. These estimates represent the discontinuity associated with obtaining the NBPTS credential on the increase (or decrease) in the likelihood of exiting a particular school, district, or the state.

Here we see evidence, largely statistically significant, that NBCTs exit the school, district, and state at a higher rate than unsuccessful applicants (these odds ratios can be interpreted in the same way as the hazard ratios in the competing risks models above). For example, our findings suggest that an applicant who scores just above the threshold on the NBPTS assessment is over 60 percent more likely to make a school exit within four years after becoming certified than an applicant who just fails the assessment. In fact, the various time spans between one and four years after certification estimate the differential likelihood of exiting a school to be in the range of 26–66 percent

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35. A potential weakness in the regression discontinuity design employed here is that coefficient estimates may be sensitive to the model specification used. We estimated the discontinuity using a first- through fourth-order polynomial expansion on the test score. The results presented in these tables are quadratic expansions of the score, but the results were largely consistent with those from model specifications that were the best fit for each.
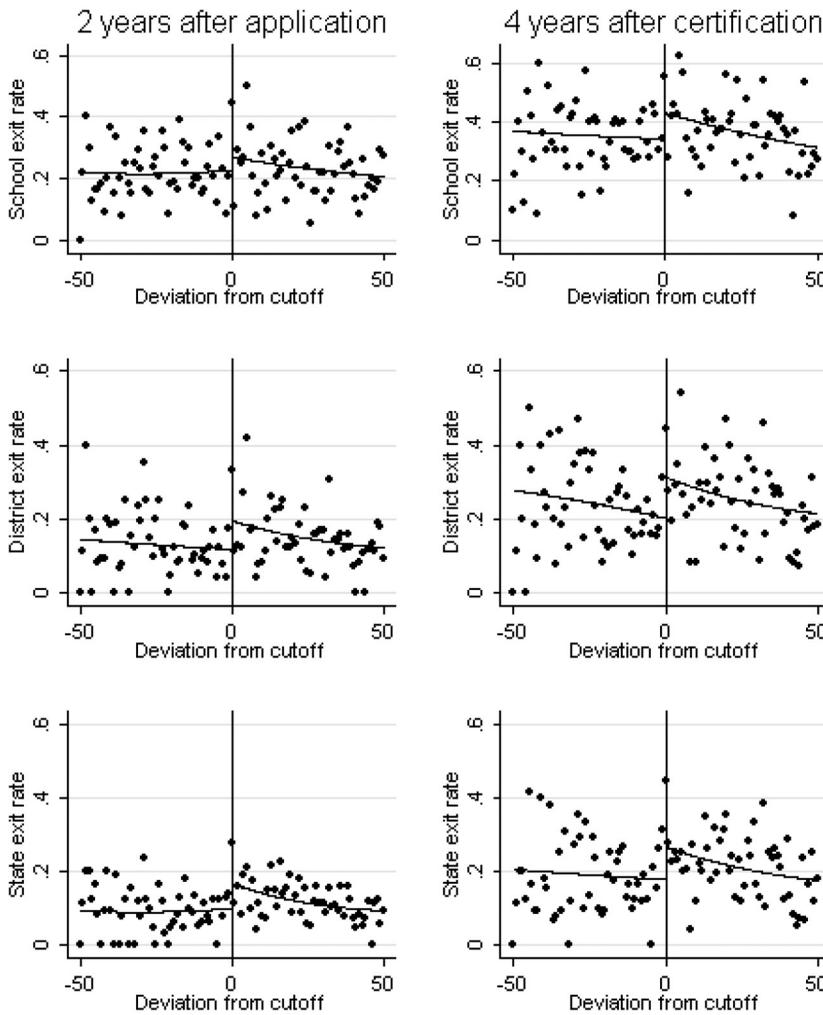
Figure 1. Discontinuity Estimates of the Differential Likelihood of Various Exit Types

greater than the initially unsuccessful applicant. The estimates for exiting the district and the state are even greater, with the increased likelihood of exits ranging from 41–89 percent and 49–84 percent, respectively. We graphically present these estimated discontinuities (for select years) in figure 1.

Also note that because state exits are nested within both district and school exits (likewise, district exits are nested within school exits), by comparing the magnitudes across move types we can get a sense of exactly what type of move is driving these estimates. All the estimates on leaving the state are large (and significant in years two and three) and are generally greater than the comparable estimates on either school or district exits for the same time period. This shows that the significance in the school and district exit
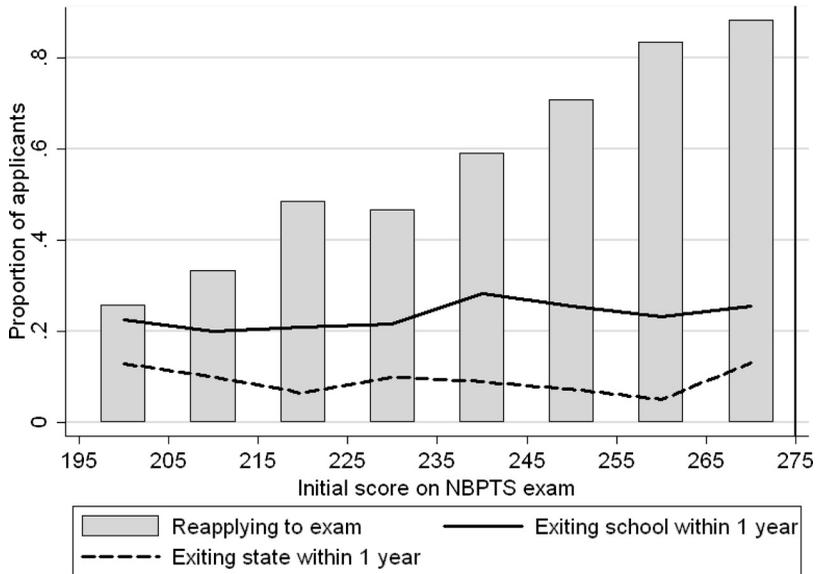
Figure 2. Exiting Behavior along the Distribution of Unsuccessful Applicants

estimates is primarily attributable to the large estimates on leaving the state and that little, if any, is due to within-state mobility arising from becoming certified.[36] These findings are contrary to what one might expect given that the state rewards NBCTs with a higher salary, but they are consistent with the estimated differentials in the competing risks models above.

A relevant question is whether these changes in turnover behavior are due to NBCTs exiting *more* as a result of passing or failed applicants exiting *less* in order to reapply for the NBPTS exam again. Either story produces results consistent with the findings we present here, and the RD design does not distinguish between these two possibilities. Thus, to address this question, we first refer back to the competing risks results presented in table 2, where we find that applicant, reapplicant, and unsuccessful applicant behaviors are all different from the baseline nonapplicant behavior but that NBCTs are not significantly different from the null. Second, we can also look at how exiting behavior changes along the distribution of unsuccessful applicants, and we illustrate this with figure 2. Here we see a clear upward trend in the proportion of applicants reapplying as their initial score on the exam approaches the cutoff at 275, but the proportion of applicants exiting either the school or the state shows

36. We performed additional regression discontinuity tests where the outcomes of interest were leaving the school (within district) and leaving the district (within state), rather than the nested outcomes presented in the tables. The results of these tests were generally insignificant, supporting our statement that the significance of the school and district discontinuities we find are largely driven by state exits and not by increasing within-state mobility.

little variation over this range and does not decrease as would be expected if reapplication induced fewer exits. Thus both the competing risks results and the behavior of unsuccessful applicants suggest that our NBCT findings are due to changes in the behavior of those who successfully obtain the NBPTS credential rather than changes in the behavior of unsuccessful applicants.

Given the increased attrition from the state among NBCTs, we further investigate this finding to see if it indicates that NBCTs are generally exiting more frequently, or whether the likelihood of exiting is related to the characteristics of the school from which a teacher initially applied. For instance, if teachers seek certification to enhance their employment opportunities in more favorable schools, we expect to see higher attrition among teachers initially teaching in schools that are unfavorable and less attrition among teachers in schools that have desirable attributes. Previous research maintains that teachers have a strong preference for schools with fewer minority students, and this one characteristic is more predictive than other easily observable attributes (Stinebrickner, Scafidi, and Sjoquist 2007; Jackson 2008). The second model under each year heading in table 4 uses this measure and its interaction with becoming certified as additional controls in our regression discontinuity design (the two models are identical except for the inclusion of these two variables).

Consistent with recent evidence (Jackson 2008) derived from an analysis of the impacts of the end of busing policies designed for integration purposes, we find strong evidence that the student composition at schools has an impact on teacher mobility. Specifically, the point estimates on the percentage of minority students at the initial school generally show an increase associated with mobility (though most are not significant). Further, interacting this measure with passing status shows an added increase (in many cases significant) in the likelihood of exiting a particular assignment. Thus, though the power of these tests is not great, we see evidence consistently supporting the hypothesis that the increase in teacher mobility from obtaining certification is greatest among schools with higher levels of minority students.

Next we turn our attention to the impact that NBPTS certification may have on the school context in which teachers are employed. In particular, we wish to investigate whether being an NBCT enables these teachers to secure more favorable teaching assignments (as measured by student body characteristics and district spending levels). We assess this in a regression discontinuity framework by comparing the changes in school characteristics among applicant teachers that move. Table 5 shows the results from this specification.

These estimates suggest that NBCTs, relative to unsuccessful applicants, sort into schools with lower poverty, which serve fewer minority students

Table 5. Discontinuity Estimates for Working Conditions among Applicant Movers, 1995–2003

Post-test comparison	Years after Initial Assessment			
	1 year	2 years	3 years	4 years
Change in percentage of free and reduced price lunch students	−0.020 (0.06)	0.029 (0.05)	−0.032 (0.04)	−0.044 (0.05)
Change in percentage of minority students	−0.134* (0.07)	−0.069 (0.06)	−0.047 (0.05)	−0.034 (0.06)
Change in district expenditures per student	−78.110 (68.11)	125.741 (80.10)	309.181*** (95.63)	176.062* (103.77)
Observations	221	363	426	266

Notes: The change is measured as the current year less the application year's observation on the given variable for each teacher. 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. All models also include a quadratic expansion on initial assessment score.
*significant at 10%; **significant at 5%; ***significant at 1%.

and have higher per student expenditures. Though only a handful of these estimates are significant (likely due to low power), the point estimates are generally consistent in sign, suggesting that the credential may enable NBCTs to move to schools with more favorable working conditions than they would be able to otherwise.[37]

On the whole, the regression discontinuity results presented in this section suggest that becoming certified increases teacher mobility out of the North Carolina system; however, the credential does not appear to influence within-state movement beyond what is observed in unsuccessful applicants. Moreover, the increased mobility in NBCTs is greatest among schools with higher levels of minority students. Among the sample of teachers who move after initially applying to the NBPTS assessment, we see evidence that successful applicants sort into significantly better teaching environments than those who initially fail, though these results are not as strong as those on exiting.

Exploring Reasons for System Exits

One of the hypothesized benefits of NBPTS is that it will encourage high-quality teachers to remain in the profession longer than they otherwise would, and one of the hypothesized benefits to North Carolina is that NBCTs would remain

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37. We also investigated the change in working conditions for all applicants, whether they moved schools or not. Generally, the point estimates are all consistent with what we expect—NBCTs appear to teach in lower poverty, lower minority, and higher expenditure schools; however, very few of these estimates are significant. Note that inclusion in these analyses is conditional on remaining in the state for the specified time period, and NBCTs have evidenced a higher likelihood of exiting the state; thus the sample may suffer from a selection bias. In the absence of an instrument to provide exogenous variation, we cannot rule out this type of bias entirely.

in the state longer. Our findings thus far suggest, if anything, the opposite (although it is important to recall that we do not know whether teachers who leave our data set leave the teaching profession). Thus we estimate several additional models to attempt to explain the finding that NBCTs are more likely than non-NBCTs to exit the North Carolina system. Specifically, we explore two possible explanations for exits from the system: NBCT exits due to retirement and NBCT exits out of the system but within the profession. As detailed below, we believe this second type of within-profession mobility is the most credible explanation for this finding.

The first possibility is that teachers are induced to retire early because the 12 percent salary supplement adds to pension wealth. Annual teacher pension benefits in North Carolina are calculated based on the average pay received in a teacher's four highest-paid years, generally the last four years of full-time employment (North Carolina Department of State Treasurer 2009). A teacher nearing retirement may choose to apply for NBPTS certification with the intention of increasing her pension benefit more dramatically than what she could through additional years of experience only. By substituting NBPTS certification for additional years of work to increase her pension benefit, a senior teacher may be induced to retire earlier than she otherwise would (Costrell and Podgursky 2008).

It is not possible that all of our findings on exits from the system could be driven by retirement behavior, since we focus on teachers at various stages in their careers and many are far from being retirement eligible. Unfortunately, we are unable to determine whether a teacher who exits the system does so because she is retiring (nor do we have information on a teacher's age), prohibiting us from computing a teacher's retirement eligibility directly. Still, we attempt to address this source of teacher exit by approximating retirement eligibility (using college graduation year and experience) and including this approximation of eligibility and years to eligibility in various models of teacher exit.

In panel A of table 6, we present the estimates from regression discontinuity tests with additional explanatory variables indicating imputed retirement eligibility and interact these with teachers' initial passing status (we focus only on state exits here). As shown, retirement and early retirement eligibility, regardless of passing status, are significant predictors of system exits. These retirement variables interacted with passing status are associated with fewer state exits, suggesting that passing the exam may induce teachers near the end of their careers to teach longer than otherwise expected; however, these estimates are generally insignificant. Thus the finding of high exit rates from the state public school system among NBCTs is not attributable to retirees.

The second potential explanation for our findings on system exits is that teachers are exiting the North Carolina system in order to work in another

Table 6. Investigating the Source of the Observed Discontinuity

Panel A. Discontinuity Estimates on State Exits Using Retirement Eligibility

	Years after initial assessment			
	1 year	**2 years**	**3 years**	**4 years**
NBCT	1.647	1.972***	1.980***	1.681*
	(0.55)	(0.47)	(0.45)	(0.48)
Retirement eligible	4.246**	1.992	2.114	1.442
	(2.56)	(1.08)	(1.00)	(0.88)
Retirement eligible × NBCT	0.193	0.875	0.688	0.880
	(0.23)	(0.77)	(0.52)	(0.84)
Early retirement eligible	1.072	1.239	1.241	2.085***
	(0.37)	(0.33)	(0.26)	(0.42)
Early retirement eligible × NBCT	0.678	0.623	0.609	0.555*
	(0.35)	(0.24)	(0.19)	(0.17)
Observations	2,521	2,521	2,521	1,444

Panel B. Discontinuity Estimates on State Exits Using Bordering Districts

	Years after initial assessment			
	1 year	**2 years**	**3 years**	**4 years**
NBCT	1.331	1.869***	1.771**	1.329
	(0.48)	(0.42)	(0.40)	(0.37)
District borders South Carolina	1.668*	1.395	1.214	1.247
	(0.49)	(0.36)	(0.27)	(0.32)
District borders South Carolina × NBCT	0.578	0.604	0.970	1.290
	(0.29)	(0.23)	(0.31)	(0.45)
District borders Virginia	1.589	1.329	0.942	1.332
	(0.85)	(0.57)	(0.37)	(0.50)
District borders Virginia × NBCT	0.178	0.275*	0.735	0.282*
	(0.21)	(0.20)	(0.41)	(0.21)
District borders Tennessee	0.643	1.119	0.933	0.903
	(0.68)	(0.67)	(0.49)	(0.46)
District borders Tennessee × NBCT	1.265	0.644	0.479	0.520
	(1.90)	(0.64)	(0.45)	(0.48)
Charlotte-Mecklenburg schools	0.440	0.887	1.232	0.668
	(0.32)	(0.48)	(0.50)	(0.35)
Charlotte-Mecklenburg schools × NBCT	10.093***	3.280*	1.563	3.001*
	(8.79)	(2.13)	(0.76)	(1.93)
Observations	2,521	2,521	2,521	1,444

Notes: Each column reports the estimated odds ratios of the impact of passing the NBPTS exam at increasing intervals beyond initial application. All models also include a quadratic expansion on initial assessment score. Indicators for districts bordering Georgia were dropped because of no variation in outcomes for applicants from these districts.
*significant at 10%; **significant at 5%; ***significant at 1%.

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state.[38] Again, our data do not allow us to address this possibility directly. However, we speculate that teachers who are employed in districts near the state borders are more likely to leave the North Carolina school system for this reason; so, to the extent that system exits are driven by teachers who are leaving to teach in another state as opposed to leaving the profession altogether, we might expect to see teachers employed in a state-border district to be disproportionately more likely to exit. We can think of no reason why this would be the case for exits that are a result of leaving the profession.

To assess this possibility, we again return to the regression discontinuity model and this time include indicators for teachers in state-border school districts and interactions of these variables with passing status. We also include an indicator for the Charlotte-Mecklenburg (CM) school district. We do this to test the possibility that teachers in this district may drive our results: CM is the largest school system in the state with a significant minority population, bordering South Carolina, and recent evidence documents that a shift in the segregation policies of the system has had an impact on teacher attrition (Jackson 2008). We report the findings for the models using the border-district/CM school specifications in panel B of table 6 (again focusing exclusively on state exits).

The reported estimates lend credence to the notion that the exits may in fact be moves into teaching positions in another state, but teachers in CM schools drive this result almost entirely. For example, teachers employed in border districts, regardless of NBPTS certification, generally show a marginally higher propensity for leaving the state system; however, the NBCT interaction estimates on bordering districts are generally insignificant. Interestingly, though, NBCTs in CM are significantly more likely to leave relative to other teachers, and this difference arises from passing the certification exam. The estimated magnitudes on the likelihood of exiting are also large; for instance, NBCTs in CM are three times more likely to exit the state system within two years, which is consistent with findings from Jackson (2008).[39] In spite of the magnitude of the estimates on NBCTs in CM, though, we still estimate a positive discontinuity around the cutoff (significant in years two and three) for NBCTs generally; thus, while NBCTs exiting CM schools appear to drive some of these results, they do not explain all the exits out of the state school system due to

38. Recall that teachers may leverage the NBPTS credential to facilitate movement within the profession but between states to more readily secure a teaching license when moving across state borders. Viewed this way, NBPTS certification would be attractive to teachers who have a higher propensity for this type of between-state movement.

39. In another RD specification, we excluded the CM schools indicators while including those on border districts. This resulted in large, significant estimates on exiting districts bordering South Carolina, which swamped the estimates on bordering other states. By including the indicators on CM schools, we find that teachers in CM primarily drive the significance of the South Carolina estimates.

receipt of the certification. These findings are quite consistent with the notion that NBCTs are being lured out of state by a financial incentive, since NBCTs in South Carolina—which borders the CM district—receive a generous $7,500 salary supplement, whereas the incentives in the other states bordering North Carolina are far smaller.[40]

5. PUBLIC POLICY IMPLICATIONS AND CONCLUSIONS

The analyses presented here suggest that, as a consequence of becoming certified, NBCTs exhibit greater employment mobility within the school system than their uncertified peers. Further, our regression discontinuity results are consistent with research on teacher preferences when making a transition—NBCTs show evidence of moving from schools with high levels of minority students to schools with more favorable characteristics (conditional on remaining in the state).

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—particularly among teachers in high-minority schools—and that it subsequently permits NBCTs to sort into better schools than otherwise expected raises equity concerns. Existing research suggests that the value of NBPTS certification is one of teacher quality rather than 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 2008). Thus our findings suggest that schools that already tend to lose teachers—that is, those with higher proportions of minority students—could be harmed as a consequence of having a readily identifiable credential ostensibly signaling teacher quality.

One potential implication of this finding is that state or local policy makers may wish to provide differential financial incentives to provide greater encouragement for NBCTs to work in disadvantaged schools.[41] A recent case study report on the distribution of NBCTs in six states shows that they are

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40. For a teacher making a $50,000 salary, this $7,500 supplement constitutes a 15 percent increase, greater than the 12 percent increase available through North Carolina (assuming the teacher's baseline salary stays constant).
41. 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 because teachers appear, again consistent with recent research, to be more concerned about the racial/ethnic makeup of a school's student body than about its socioeconomic makeup (Stinebrickner, Scafidi, and Sjoquist 2007).

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 incentives are available to any NBCT regardless of teaching assignment (Humphrey, Koppich, and Hough 2005).[42] This study suggests that targeted financial incentives are an important component of a more equitable distribution of NBCTs but that incentives alone may not be enough, as other working-condition factors (for example, school resources, principal leadership, or collegiality of teaching staff) are also important in determining where teachers opt to work.

A significant and interesting departure from what one might assume (given the large supplement received by NBCTs in North Carolina) is that obtaining the NBPTS credential appears to increase the probability that a teacher will leave the North Carolina system. The evidence we present suggests that this is due to NBCTs exiting more and not due to unsuccessful applicants exiting less. As evidenced in supplementary tests on this finding, we feel the most credible explanation is that NBCTs who are exiting the North Carolina system are not by and large leaving the teaching profession but are obtaining the NBPTS credential in order to enhance their employment options in other states or in other schools outside the public system. Unlike many states, North Carolina is a net importer of teachers, so many of the teachers in the state may work in schools far away from where they were raised and attended high school. Since research has shown 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 as a vehicle to move to a teaching position in another state.

An important nuance to our North Carolina findings is that the impact of certification on teachers' career paths cannot be separated from the income effect due to NBCTs' receipt of the 12 percent salary supplement. Because North Carolina's rewards are generous compared with most other states, we are led to believe that states with fewer rewards for certification will likely experience a similar or perhaps an even lower level of retention among their newly minted NBCTs.

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

in this article do not necessarily reflect those of the University of Washington or the study's funder. Responsibility for any and all errors rests solely with the authors.

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