NBPTS Certification: Who Applies and What Factors are Associated with Success?

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Abstract

National Board Certification represents one of the most significant reform efforts in the area of teacher quality in the last two decades. Since the National Board for Professional Teaching Standards (NBPTS) certified its first round of teachers in 1995, approximately 24,000 teachers have become certified at a cost to the country of well over $200 million, yet no large-scale quantitative research exists on the candidates of the program and their effectiveness in educating children. Since 1995, we have seen significant growth in NBPTS application and certification rates. In this paper, we describe the results of a study of teachers in North Carolina assessing the factors associated with the decision to apply to NBPTS and the factors associated with successful certification. We find that with all else equal, those teachers who are African-American, and/or female, score higher on standardized tests or are younger are more likely to apply for certification. With respect to NBPTS certification, we find that African-American and male teachers are less likely to be certified. Finally, we find that teachers who score higher on standardized tests are more likely to be certified.

I. Introduction

Educational policymaking over the last twenty years has been widely influenced by the standards movement, which calls for higher standards for student performance. Increasingly, policymakers have recognized that for students to meet high standards, their teachers must also be of high quality. The National Board of Professional Teaching Standards (NBPTS) was created in 1987, as an outgrowth of the Carnegie Forum on Education and the Economy, to help increase the overall level of teacher quality and professionalism by establishing high standards for what accomplished teachers should know and be able to do and by recognizing teachers who meet those standards. Since its inception, many policymakers and educators have identified the NBPTS certification process as an important way to identify effective teachers as well as a mechanism for improving the quality of the teaching workforce.

NBPTS advocates argue that NBPTS has created a formal process whereby experienced, outstanding teachers with demonstrated skills would be appropriately recognized. They see the National Board as a potential bulwark against the rising tide of teacher mediocrity and an important step towards greater recognition and respect for teaching as a profession. The hope among advocates is that NBPTS teachers can lead in changing school culture and practices in ways that ultimately have significant beneficial impacts on students. NBPTS is supported by groups like the National Commission on Teaching and America's Future (NCTAF) (1996), which called for at least one National Board certified teacher in each of the country's 105,000 schools by 2006. Reports by the American Federation of Teachers (2000) and the American Council on Education (2000) also support the expansion of NBPTS certification.

Critics, by contrast, contend that NBPTS is primarily an insiders' organization that bases its authority on the evaluation of its own members. The inclusion of two prominent educators' unions on the Board also raises red flags for some (Wilcox, 1999). The relatively few studies which do assess the impact of NBPTS have been criticized both for a lack of independence from the organization and for a focus on teaching methods rather than student outcomes. There is also concern that significant amounts of federal and state funding have gone to support an institution that has yet to clearly demonstrate success in raising student achievement (Ballou and Podgursky, 1998).

Despite these concerns, widespread belief in the NBPTS model has prompted many states to subsidize the initial $2,300 assessment fee (cost of application) for individual teachers and to award bonuses or salary supplements to successful candidates as well. According to NBPTS, in 2002 at least 47 states provided at least one form of incentive for National Board Certification,

and 32 states provided salary supplements (NBPTS.org). To date, however, very little research has been conducted on the recipients of this investment: those who seek NBPTS certification and those who are certified. To our knowledge there are no large-scale quantitative studies on the individual, school, district, and community factors that are associated with the decision to apply to NBPTS and the likelihood of certification, conditional on application. Thus, it is not known whether the financial incentives that districts may offer NBPTS certified teachers lead to higher rates of application. Information on these issues could help states and districts craft effective incentive policies, in addition to clarifying their perceptions of the value of NBPTS certification. In this study, we explore the factors that are related to both teachers' decisions to seek NBPTS certification and the candidates' ultimate success in the certification process.

Our research utilizes data provided by North Carolina on its teaching workforce and data from NBPTS on National Board applicants to relate the characteristics of North Carolina teachers and their school districts and communities to their probabilities of applying for and receiving NBPTS certification. We focus on two topics in particular: the factors associated with NBPTS application and whether or not those factors have changed over time, and the factors associated with NBPTS certification, given application, and whether or not they have changed over time.

We find significant increases in application rates (the number of teacher applications per total eligible teachers) and certification rates (the number of certifications per applicant) in North Carolina in the 1997 to 2000 time period (see **Figure 2**). The increase in the application rate appears to result primarily from an increase in the underlying propensity to apply to NBPTS, while the increase in the certification rate appears to result primarily from changes in the applicant pool. All else equal, women and African-Americans teachers are more likely to apply to NBPTS, as are those teachers who perform better on standardized tests. Conditional on application, we find men and African-American applicants are less likely to be certified, while teachers performing better on standardized tests are significantly more likely to be certified. Low-income, high-minority student populations are less likely to have access to NBPTS certified teachers in their schools. This finding is partially explained by lower certification rates among applicants at schools serving more disadvantaged students.

The paper is laid out as follows: Section II provides some background on the types of financial support offered to NBPTS candidates, successful applicants and the NBPTS assessment process itself. The data and methodological approach used in this study are described in Section

III, and our findings are described in Section IV. We report the results of simulations based on our findings in Section V, and Section VI offers some concluding thoughts.

II. Background

As described above, implementation of the NBPTS model has resulted in significant monetary investments in both NBPTS candidates and successful applicants. In North Carolina, for example, the state pays the $2,300 assessment fee for all teachers who apply for NBPTS certification, allows teachers three days of release time to complete the assessments, and provides those who become NBPTS certified a 12 percent pay increase over the ten year life of the certificate. These incentives represent both a significant financial gain to successfully certified NBPTS teachers and a substantial investment by state governments. For example, for each successful NBPTS applicant in the year 2000, the state of North Carolina will, on average, invest almost $45,000 over the ten year life of the certificate. Based on the pool of approximately 2,000 NBPTS applicants and 1,000 new NBPTS certificates in the state in 2000, this represents an estimated annual outlay of almost $50 million (see **Figure 1)**.[1] Moreover, as of 2002, at least 300 school districts nationwide, including several in North Carolina, provided local salary supplements to successful candidates in addition to any state incentives.

States and school districts are not the only financial contributors to the National Board Certification movement. As of October 2002, the NBPTS website reports the receipt of more than $100 million in federal funds and more than $100 million from non-federal sources (including foundations, private corporations, and individuals) to assist in the development and implementation of National Board Certification of teachers. Thus, at a minimum, well over $200 million nationwide has been invested in the NBPTS model.

Though the nation is far from the goal specified by the National Commission on Teaching and America's Future of 105,000 NBPTS certified teachers, the number of NBPTS applicants and certified teachers has grown rapidly as states, through a variety of incentives (e.g. financial incentives, mentors, etc.), have encourage teachers to go through the NBPTS process. These incentives may help explain the dramatic growth in the number of NBPTS applicants and certified teachers. The program began by certifying less than 100 teachers in 1994-95; in 1999-2000 that number rose to just over 9,500, and by autumn 2002 it had increased to 22,000 teachers certified nationwide. **Figure 2** shows the growth in NBPTS applications and certifications in North Carolina from 1997 to 2000. The figure also reports the *yearly certification rate* – the number of certified teachers in each year divided by the number of applicants in that year –

which rose substantially from 41 percent in 1997 to 52 percent in 2000. The cohort certification rates – the number of individuals who apply in a given year who are eventually certified – are higher due to the fact that some individuals who do not pass the first time they apply to NBPTS are successfully certified based on a later attempt.[2]

In order to obtain NBPTS certification, candidates must undergo an extensive assessment process that generally requires from six to eighteen months for completion.[3] Candidates must first submit a portfolio documenting their classroom practices (including two videotaped classroom interactions and two collections of student work and teaching artifacts) and their community and professional involvement. Additionally, candidates must answer essay questions assessing their content and pedagogical knowledge relevant to the certification area. Applicants are scored on a scale of 75 to 425, incorporating both the portfolio and the assessment center exercises, and they must earn a score of at least 275 to achieve certification. As of 2002, there are 26 certification subject areas ranging from a generalist certificate for teachers who teach multiple subjects, to subject-specific certificates in language arts, science, history, art, and physical education. Certificates are available in four age levels: early childhood, middle childhood, early adolescence, and adolescence through young adulthood.

NBPTS certification provides teachers in many districts with a venue to advance professionally without leaving the classroom. Under traditional systems of hiring and promotion, teachers enter the profession after having obtained a license, usually by completing the requisite coursework and passing a licensure examination (Goldhaber and Brewer, 2000). In many states teacher receive tenure after teaching for a specified period of time, often three years. Teachers who reach this stage generally have a high level of job security and receive pay raises based solely on years of service and educational level. In many states and localities, obtaining NBPTS certification is a way for experienced teachers to receive additional pay increases based on their skills. The thought is that experienced teachers can be certified for teaching to high standards, and rewarded with recognition and remuneration. Such teachers would then be more likely to remain in the classroom, where their professional strengths lie, and could additionally act as mentors to other teachers, helping their colleagues teach to high standards. By seeding schools with such teachers, NBPTS hopes to improve the quality of the school culture as well as teaching force as a whole (see Porter et al., 2000 for a description of the role of NBPTS in teacher careers).

III. Data and Methodological Approach

Data

Data for our analyses were drawn from the following sources: administrative teacher records maintained and provided on all teachers employed by North Carolina from 1997 through 2000 by the North Carolina Department of Public Instruction (NCDPI); school performance measures based on student tests from the NCDPI website; information on NBPTS assessment results from 1997 through 2000 provided by NBPTS and Educational Testing Service (ETS); various school-wide and district/community characteristics for 1997 to 2000 from the Common Core of Data (CCD); and data on individual school districts' incentives for NBPTS certified teachers gathered through phone interviews with local school officials. Four resulting databases were created for each year between 1997 and 2000 with over 70,000 teachers in each year. These year datasets with merged with one another to create a four-year panel of teachers. From these data, we create two separate samples, both at the teacher level, for different aspects of the current study: 1) the *full NBPTS-eligible teacher sample*, and 2) the *applicant sample.*

The *full NBPTS-eligible teacher sample* includes 251,567 teachers employed by the state of North Carolina who are credited with at least three years of teaching experience for salary purposes and who have not previously been NBPTS certified.[4] We restrict the sample to those teachers with at least three years of experience because teachers only become eligible to apply for NBPTS certification after three years of teaching.[5] Since we are interested in teachers' information at the time of application, we code individuals as applicants in the year in which they apply. This sample matches teachers to the schools and districts in which they taught at the time of application.[6]

The *applicant sample* includes the 4,246 teachers with three of more years of experience who actually *applied* to NBPTS in the state of North Carolina from 1997 to 2000.[7] The applicant sample is created from the *full NBPTS-eligible sample* and has additional variables related to NBPTS application and certification, including each applicant's and certified applicant's certification area as displayed in **Figure 3**.

The data for all teachers includes several different test scores for teachers in the NCDPI database, such as Praxis generalist tests (Praxis I), Praxis subject tests (Praxis II), the National Teacher Exam (NTE), and in some cases, teachers' SAT and GRE scores. We retained only teacher test scores that fall into the proper range for each particular test (e.g. if the range of possible scores for a test was between 100 and 200, and the recorded score was a 54, we set that score equal to missing). To account for differences in test scores of the various tests that teachers have on their record, we converted test scores into Z-scores so as to place them on a common

metric. For teachers with test scores on multiple tests in the same year, we averaged all of the Z-scores into one composite test score. The most current scores were used in cases where teachers' records included multiple scores on the same tests.

The state of North Carolina began requiring teachers to take Praxis II as the primary teacher licensure test in the second half of the 1990's, thus many of the older teachers in the state do not have Praxis II scores. These teachers often have other tests on their state record such as the NTE, GRE, and even SAT, therefore the use of Z-scores allows us to maximize the numbers of teachers for which we have test information. As displayed in the **Appendix B**, our Z-score variable is highly correlated with the Z-scores of individual teacher licensure tests like the Praxis I and II, and the NTE.

Furthermore, in the analyses described below, we experimented with including each type of test individually (e.g. we estimated separate regressions for the sample of teachers that only had Praxis II test scores), as well as different combinations of test averages. We found that all the coefficients were broadly consistent in sign and statistical significance across all measures of the test score variable.

Methodological Approach

We begin by presenting descriptive statistics of the characteristics of teachers, schools, districts, and communities in our data, and focus on differences that exist by NBPTS application and certification status. We then estimate regressions of the probability of application, the probability of certification, and the NBPTS assessment score.

In the first stage of our regression analyses, we are interested in the factors associated with the decision to apply to NBPTS. Here we use the *full NBPTS-eligible sample* of teachers because we wish to learn about the association between individual, school and school district characteristics and application when the decision on application occurs. In the second stage, we use the *applicant sample* to estimate the probability of success among NBPTS applicants. In the final stage, we use the *applicant sample* to estimate the factors influencing the NBPTS assessment score achieved by applicants.

The dependent variables in the first two stages of our regression analyses (application and certification) are binary (e.g. one either decides to seek NBPTS certification (1) or not (0)), thus we utilize a binomial logit. More formally we estimate the following model:

$$\Pr(I_i = 1) = \frac{\exp(District/Community_i\alpha + School_i\beta + Teacher_i\delta)}{1 + \exp(District/Community_i\alpha + School_i\beta + Teacher_i\delta)}$$

I_i is equal to 1 if individual i attempts National Board Certification (in the case of the application models), or is certified conditional on application to NBPTS (in the certification models).

We include measures of teacher characteristics (demographics, educational background, test scores, salary, and licensure information), school characteristics (size, student performance levels, demographics), district characteristics (size, per pupil expenditures, demographics, and urbanicity), and community characteristics (community wealth, demographics, housing values and education levels) as controls.[8] Using the results from these models, we can estimate the marginal impact of any of these characteristics on the outcome of interest.[9]

We are particularly interested in the relationships between NBPTS outcomes: application, certification, and NBPTS assessment scores and several of our explanatory variables: teacher race and gender, teacher Z-scores, district financial incentives, school year, and the interaction between teacher Z-scores and the school year. As we present in the descriptive analyses, women have been applying at much higher rates than men, and African-Americans have been getting certified at much lower rates than whites. As such, it is important to determine whether race and gender are in and of themselves the determinant factors, or whether there may be other characteristics of women and African-Americans that may be highly correlated with their application and certification probabilities.

With respect to the financial incentive variables, as mentioned above, several districts within the state offer such incentives, ranging from a one-time bonus of $300 to a $2,000 per year salary increment awarded to teachers who gain certification. The fact that there is variation within the state in NBPTS incentives allows us to estimate the marginal impact of incentives on the likelihood of application and successful NBPTS certification.

We also focus on teacher Z-scores and interactions between the Z-scores and the school year variables.[10] Some research suggests that individuals who score higher on certain forms of standardized tests tend to be more effective teachers, as measured by students' performance on standardized tests (Ehrenberg and Brewer, 1994; Ferguson, 1991, 1998; Strauss and Sawyer, 1986), and as National Board Certification is assumed to accurately identify these qualities in teachers, we are interested in finding out more about the relationship between teacher Z-scores and NBPTS application and certification. Examining the results of the teacher Z-score variable interacted with the year dummy variables provides an indication of the degree to which the

NBPTS assessments, all else equal, may be getting less selective -- as the overall increase in both the number of NBPTS candidates and the certification rate of applicants might suggest. We also examine the broader issue of whether the pool of NBPTS applicants and certified teachers has changed over the years. Of course, it is also possible that certification rates could vary by year as a result of changes we are not able to take into account (e.g. the amount of preparation done by the applicants).

Finally, we focus on a series of variables created to capture the potential peer effects on application and certification of having other current NBPTS applicants and previously certified teachers, as well as previously unsuccessful NBPTS applicants, in a school or district.[11] We might expect, for instance, a mentoring effect -- that is, teachers in schools with more NBPTS certified teachers might be more likely to both apply to the National Board and be more successful in obtaining certification since they would conceivably have a better source of ready knowledge about the NBPTS process. These variables may be correlated with characteristics of schools and districts unobservable in the data but related to the probability of application and certification. Thus, it may be appropriate to view these variables as proxies for other factors associated with these outcomes.

As described above, included in our data is the assessment score on which NBPTS certification is based. Thus, in addition to estimating logistic application and certification models, in the final stage of our analyses, we estimate linear models of the factors predicting NBPTS assessment scores. The variables included in these models are the same as those in the certification models.

Finally, we use the results from the models discussed above to perform a series of simulations. We provide several simulations that show how application and certification rates vary over time, holding constant individual teacher, school, district, and community variables. We also examine how application and certification probabilities and NBPTS assessment scores are predicted to change for teachers with varying test score performance. To assess the impact of context on application and certification probabilities, we simulate what the application and certification rates would be for teachers who switch from an affluent school/district/community to a poorer school/district/community. Finally, we simulate the impact of changes in local financial incentives provided to NBPTS certified teachers on the number of NBPTS applicants certified teachers as well as the associated local and state NBPTS-related costs.

IV. Results

Our estimation strategy follows the outline in the analytic approach. We begin with a descriptive analysis of our data, and then estimate models of application to NBPTS. Next, we turn to models of NBPTS certification given NBPTS application, and finally, we estimate models predicting an applicant's NBPTS assessment score.

A. Descriptive Results

As shown in **Figure 2**, in North Carolina the number of applications to NBPTS has risen substantially each year, representing a tremendous increase in the application rate from 0.2 percent of teachers in 1997 to a high of 3 percent of teachers in 2000. The certification rate on the exam in the applicant sample rose as well, from 41 percent in 1997 to over 52 percent in 2000 (see **Figure 2**).[12]

Comparing teachers by application status (in **Table 1**), we find that NBPTS applicants are much more likely to be female than male (women make up 91 percent of the applicant pool, but only 82 percent of non-applicants) and more likely to have a higher Z-score. They are also significantly more likely to hold a masters degree (43 percent of applicants, compared to 28 percent of non-applicants). In addition, those teachers who applied are more likely to have continuous licenses, meaning that that teacher has completed the needed coursework/tests for their area through the five-year cycle of that license (as opposed to an endorsed, vocational, temporary, provisional or emergency licenses) than those who did not apply and are more likely to have received training from in-state education programs.

There are few differences in school and district characteristics by application status, with one major exception. A small number of local school districts (11 of 117 districts in 2000) offer financial incentives to NBPTS certified teachers, in addition to the 12 percent salary incentive provided by the state of North Carolina (**Table 2**). One type of financial incentive offered by seven districts in 2000 is a one-time bonus for those who successfully in obtain NBPTS certification. Among those districts offering this type of incentive in 2000, the mean bonus was $494.[13] A second type of incentive offered by four districts in 2000 is a permanent increase in salary for those who are successfully certified. Among those districts offering this type of incentive in 2000, the mean salary supplement was $768 per year. NPBTS applicants were more than 50 percent more likely than non-applicants (9.7 percent compared to 6.1 percent) to teach in a district that offers at least one form of financial incentive. The differences in application rates

for these different districts at least suggest that a relationship exists between the presence of a NBPTS financial reward for teachers and NBPTS application rates. However, as shown in **Table 2**, districts that offer financial incentives are generally more advantaged, as measured by higher median housing values and lower child poverty rates. Thus, it is premature to assume that the higher application rates we observe are causally related to the incentive itself.

Upon examination of the NBPTS applicant sample, we see some stark differences between successful and unsuccessful candidates. Not surprisingly, there is a large differential in the average NBPTS assessment scores of those who achieved certification and those who did not: 302 was the mean assessment score for NBPTS certified applicants, compared to 241 for non-certified applicants. We also find striking disparities between NBPTS certified applicants and non-certified applicants by race. African-American teachers constitute approximately 13 percent of the applicant pool, but only 4 percent of those applicants who successfully obtain NBPTS certification. There are also significant differences in Z-scores between successful and unsuccessful applicants; in fact, the difference in average test score between the NBPTS certified applicants and the non-certified applicants is more than half a standard deviation, suggesting that some of the same qualities traditionally linked with high student performance are being recognized and rewarded in the National Board Certification process.

An examination of the school characteristics shows that certified applicants are, on average, employed in schools with a lower proportion of minority and poor students, and are in schools that met or exceeded student growth expectations set according to state accountability standards. The district and community characteristics largely reflect similar demographic trends as found for the school variables. NBPTS certified applicants, on average, taught in districts and communities with fewer children in poverty, fewer minority children, more college-educated residents, and higher median housing values. These data indicate that while North Carolina as a whole has seen its teachers achieve National Board Certification at a higher rate than any other state, the schools and districts with the most at-risk students, namely, the low-performing, poor, and predominantly minority schools and districts, do not have a proportionate share of NBPTS certified teachers.

B. Application Models

Columns 1 and 2 of **Table 3** show the estimated marginal effects of the teacher, school, district, and community characteristics on application probabilities. The first column is the base

model, while column 2 is the district fixed-effects specification. We use a district fixed-effects model in which we drop all district-level and community variables in order to capture unobservable effects that may be occurring at the district-level as whole, outside of the quantifiable district and community variables in the dataset.[14] It is worth noting that most of the estimated effects change very little when we include district level fixed-effects.[15]

In both model specifications, we find teachers who are African-American, female, younger, and/or earning higher salaries, and who have been teaching for less time are more likely to apply for NBPTS certification. Though the estimated marginal effect sizes are relatively small, the predicted percentage difference in the application rate is sometimes quite large given that the application rates are so low in each year. For example, while African-American teachers are almost a half percentage point more likely than white teachers to apply for National Board Certification, and women are approximately 1.3 percentage points more likely to apply than men, these percentage point increases represent increases in the likelihood of application of about 25 percent for blacks and 75 percent for women, respectively (based on the overall sample application rate of 1.7 percent).

The age and salary findings are generally consistent with what one might expect given that those earning more receive a larger bonus for becoming NBPTS certified (as the state provides a 12 percent increase in their salaries) and younger teachers have a longer time horizon to recoup the time and energy investment required to go through the NBPTS assessment process.

Many of the school and district peer effects variables are strongly correlated with the likelihood of application. All else equal, we find that teachers are more likely to apply to NPBTS if there are other teachers in the *district* currently going through the process, and less likely to apply to NBPTS if they are from districts with higher numbers of past unsuccessful NBPTS applicants. The peer effects at the school level are stronger. Teachers in *schools* with more prior successful applicants are more likely to apply for NBPTS certification, while those in schools with more prior unsuccessful NBPTS applicants are less likely to apply. As was the case with districts, teachers in schools with other current applicants are more likely to apply.[16] These results indicate that teachers may be encouraged to apply by seeing evidence of their peers' prior success, and discouraged by seeing peers' prior failure. The finding that having other applicants in a district or school increases application probabilities suggests that application may depend, at least in part, on having a peer support group who has experience with the NBPTS process or is currently going through the process.

As noted in **Table 1**, NBPTS applicants, on average, taught in districts and communities with fewer children in poverty, fewer minority children, higher education expenditures, more college-educated residents, and higher median housing values. However, based on these means, we cannot directly infer whether there are more NBPTS-certified teachers teaching in these types of districts because it is easier to be certified if one is teaching in districts with particular characteristics or because the types of teachers teaching in particular districts are more likely to become certified. As we discuss below, simulations of application rates suggest that these school**,** district, and community variables account for some of the differences we observe in application rates across individuals. However, the teacher characteristics also play an important role in explaining certification, and the teachers teaching in more affluent districts have those characteristics associated with higher application rates.

Next we turn to an examination of teacher credentials. Although there is considerable debate over the impact of degrees and licensure on student outcomes, these measures are commonly used to gauge teacher quality.[17] We find that teachers with Master's degrees and those who have a permanent teaching license and received their license from a North Carolina-approved teacher training institution are significantly more likely to apply to the National Board. We also find that teacher Z-scores have a strong association with the likelihood that teachers attempt NBPTS certification. For example, a teacher scoring 1 standard deviation above the mean test score is predicted to have a 0.4 percentage point (almost 25 percent) greater likelihood of applying for NBPTS certification.[18] The use of this variable as a measure of teacher quality is debatable, but as mentioned above, several studies do find a strong association between teacher performance on standardized tests and student outcomes.[19]

Given the dramatic increase in average application rates, we are interested in estimating whether the quality of applicants to NBPTS is changing over time, using teacher Z-score as a proxy for teacher quality. In particular, one might imagine that if it has become easier to achieve NBPTS certification, lower-skilled applicants would be induced to apply. Focusing on the school year variables and the interaction terms between teacher Z-score and school year variables provides an indication of whether, all else equal, application rates are rising, and in particular, whether lower skilled teachers are more likely, over time, to apply. The positive and significant findings on the year dummy variables suggest that, all else equal, the underlying propensity to apply to NBPTS is rising. The insignificant interaction (between the year dummy variables and teacher Z-scores) coefficients, by contrast, suggests no significant change in the direct relationship between teacher Z-scores and application probability. One possible explanation for

this is that as schools and districts have become familiar with the NBPTS model, they are carefully targeting their teachers, thus encouraging stronger candidates to apply for National Board Certification. Teachers with higher test scores may also be more likely to apply knowing that teachers similar to them (in terms of teacher Z-scores) were more likely to be certified in the past.

Our district variables of interest are the district incentives for National Board Certification: the one-time bonus and the teacher salary increment. We find the estimation of the effects of the incentives to be quite sensitive to the inclusion in the models of variables identifying how many other NBPTS applicants and certified teachers are in schools and districts in which potential applicants are employed. In particular, in models that include these peer effects variables the estimated effects of both incentives are greatly reduced.[20] The coefficient on the bonus incentive goes from being statistically significant and positive to indistinguishable from zero when peer-effect variables are added to the model. The magnitude of the coefficient on the salary incentive is greatly reduced and it is only statistically significant at the 19 percent level. This suggests that there is a correlation between districts offering financial incentives and other factors at the district level (i.e. number of other NBPTS applicants, certified and non-certified teachers) that influence teachers to apply to NBPTS.

In summary, we find that, *ceteris paribus*, application rates have in fact been rising, but there is no statistically significant change in the direct relationship between teacher Z-scores and application probabilities. Teachers who are African-American, female, have higher test scores, are younger and earn higher salaries are more likely to apply for National Board Certification. In addition, having an advanced degree and a permanent, North Carolina-based teaching license significantly increases a teacher's probability of NBPTS application. Teachers who have previously applied to NBPTS are also more likely to apply to NBPTS than those who have never applied.

C. Certification Models

Columns 3 and 4 of **Table 3** show the estimated marginal effects of the teacher, school, district, and community characteristics on the probability of certification among NBPTS applicants.[21] As was the case in the application models, there is a great deal of similarity in the sign and statistical significance of the coefficients in the base and fixed effects model specifications. The school level peer effects variables appear at first blush to impact the likelihood of certification.[22] Consistent with expectations, teaching in a school with teachers

who have previously obtained NBPTS certification appears to be positively associated with higher certification probability, while teaching in a school with more unsuccessful prior NBPTS applicants appears to be marginally negatively associated with certification probability. When we estimate district fixed-effects models specifications, however, the significance of these school peer effects variables disappears, indicating unobservable district characteristics that affect both the number of previous applicants (successful and unsuccessful) and the chances that a current applicant will be certified.

In both model specifications we find the impact of teacher Z-scores to be highly significant and positive, and the effects are quite large. All else equal, an increase of one standard deviation in the test score is estimated to raise the likelihood of NBPTS certification by just over 20 percentage points, or 45 percent based on the 48.5 percent mean certification rate.

The coefficients on the interactions between year and teacher Z-score are not statistically significant, indicating there is no significant change in the direct relationship between teacher test performance and certification in years which NBPTS applicants were certified. However, the year 2000 dummy is statistically significant in the district fixed effects model, suggesting that, all else equal, the probability of certification in fact increases for candidates who applied to NBPTS in 2000 when controlling for unobservable district effects (as shown in column 4 of **Table 3)**.

Our application models showed female teachers to be more likely to apply; they are also more likely to be certified, given application. Holding other factors constant, we find female teachers are about 14 percentage points more likely to be certified than male teachers. Based on a mean certification rate of 48.5 percent, this is about a 30 percent greater likelihood. Two other notable findings are that teachers with Master's degrees have about a 6 percentage point greater probability of becoming NBPTS certified than teachers with a Bachelor's degree, and that younger applicants have considerably greater success in the certification process than their older counterparts.

The key school level variable that is statistically significant in this model is the proportion of students eligible for free lunch. All else equal, teaching in schools with a higher percentage of students eligible for free lunch decreases the likelihood of being certified. Our point estimate suggests a 10 percentage point increase in the proportion of students on the free-lunch program decrease the probably of a teacher in that school being certified by 1.6 to 2.2 percentage points, or roughly 3 to 5 percent. We return to the issue of how school, district and community characteristics affect the probably of NBPTS certification when we discuss the simulations.

Comparing our application and certification models, we find some interesting differences. Most striking is the disparity in certification among applicants by race. Recall that in the application model, we found that African-American teachers, holding all other factors constant, were almost 30 percent more likely than white teachers to apply for certification. The mean certification rate for African-American applicants is approximately 16 percent, while the mean certification rate for white applicants is over 53 percent. Part of the likely explanation for this is that, on average, white teachers in North Carolina score more than 1.1 standard deviations higher on their standardized tests than African-American teachers do. The test score gap, however, does not explain the entire difference in certification probability: on our regression models, all else equal, African-American applicants are 33 percentage points less likely to obtain NBPTS certification than white applicants. Since the mean certification rate for the sample as a whole is equal to roughly 48.5 percent, this represents a difference in certification rates from whites in the neighborhood of 68 percent. Interestingly, while experienced teachers are less likely to apply to NBPTS, they are more likely, given application, to be certified.

To recap our certification model results, we find teacher gender, race, and teacher standardized test scores to be most highly associated with a candidate's success in obtaining National Board Certification. We also find school poverty level, and individual age, years of teaching experience and salary level to be influential variables in the certification models. [23] There does not appear to be any direct evidence that obtaining National Board Ccertification has become easier over the years.

D. NBPTS Assessment Models

Columns 5 and 6 of **Table 3** report linear models predicting NBPTS assessment scores. For the most part, the results from these models are consistent with the certification models discussed above. Holding all other factors constant, African-Americans and males attain significantly lower scores than whites and females, by margins of approximately 25 and 14 points, respectively. Holding a masters degree increases assessment scores by about 6 points, and an increase of one standard deviation in teacher Z-score results in over a 20-point jump in NBPTS assessment score. We found that lower minority student representation at the school level, lower child poverty rates at the district level, and higher median housing values in the community are also associated with higher NBPTS assessment scores.

The only major difference between the certification models and the NBPTS assessment models arises in regards to the teacher Z-score. The teacher Z-score variable is positively

associated with all of our outcomes of interest (application, certification, and NBPTS assessment score), but the findings on the interaction terms between the teacher Z-score and the school year terms differ somewhat between models. In particular, the coefficients on the interactions between the school year and the test score are negative and not significant in the certification models. In the NBPTS assessment score models, these negative coefficients are statistically significant, meaning that the impact of increases in teacher Z-scores on the assessment scores is significantly smaller in each year subsequent to 1997. One potential explanation for this difference in findings is that the impact of teacher Z-scores tends to be concentrated at the tails of the NBPTS distribution, rather than at an interval of the distribution that makes the difference in determining an applicant's success. An alternative possibility is that few NBPTS applicants are clustered just below the 275 threshold so a small decrease in the effect of the test score on the NBPTS assessment score does not translate into a drop in the likelihood that teachers with high test scores are likely to become NBPTS certified. However, if this trend were to continue or to be more concentrated around the threshold score of 275, we would anticipate that it would have an impact on the overall probability of becoming certified.

V. Simulations

We use the models specified in columns 1 and 3 of **Table 3** to perform a number of simulations that address the questions laid out in the first section and illustrate the major findings reported above. The first two simulations examine how the overall probabilities of application and certification change over time and the degree to which those changes are driven by changes in the NBPTS applicant pools in each year. Here we simulate a hypothetical teacher with characteristics equivalent to the sample mean from 1997 and ask what would be that teacher's likelihood of application (see **Figure 4**) and certification (see **Figure 5**) in subsequent years. We also simulate the NBPTS assessment scores for our hypothetical teacher (see **Figure 6)**. We find that application rates are predicted to rise substantially over time, and that certification rates as well as NBPTS assessment scores rise as well. Although the simulated certification rates are higher in years subsequent to 1997, these increases are not statistically significant, while the increases in NBPTS assessment scores are.[24] The NBPTS assessment score is predicted to increase by an 8-point amount and is statistically significant.

The next set of simulations are used to examine the relationship between teachers' academic skills, as measured by their Z-scores, and their probabilities of application (**Figure 7**)

and certification (**Figure 8)**. We also simulate the impact of changes in teacher Z-scores on the NBPTS assessment score (see **Figure 9**).

In each year there is a strong positive relationship between teacher Z-score, application and certification probabilities, and NBPTS assessment scores. The relationship, however, changes slightly over time. The general counterclockwise rotation of the lines over the years reported in **Figure 7** shows the correlation between teacher Z-score and application probabilities to be growing over time and is statistically significant. The relationship between teacher Z-score and application is strongest in 1999 and slightly decreases in 2000. The decreasing slope in the lines across the years in **Figure 8** indicate that the relationship between teacher Z-scores and the probability of achieving NBPTS certification, conditional on application, has weakened somewhat over that same time period. The effect reported in **Figure 8** *is not* statistically significant, while the clockwise rotation of the line representing the relationship between teacher Z-scores and NBPTS assessment scores in Figure 9 *is* statistically significant, indicating a slightly weaker correlation between teacher Z-scores and assessment scores over time.

In order to more closely examine the dynamics of this relationship over time between teacher Z-scores and NBPTS assessment scores, we added additional variables that identify the test quartile of teachers (quartile 1 includes the lowest-scoring teachers, and quartile 4 includes the highest scoring teachers). We include these variables along with interaction terms between these quartiles and the school year variables to determine which teachers have been most affected, and to what degree, by these changes.[25] In the application model, the only finding significant at the 90 percent confidence level is that teachers in the top quartile of test scorers in 1998 apply at higher rates than they did in 1997. In the certification model, there are no significant findings for the test score quartile year interaction variables, indicating that there are no major changes over time in the likelihood of certification for teachers whose test scores fall at different points on the test distribution. In regards to NBPTS assessment scores, we find that teachers in the top Z-score quartile score lower in 1998, 1999 and 2000 than in 1997.

To further investigate the impact of the school, district, and community context in which teachers are teaching on the probabilities of application and certification, we simulate the impact on these probabilities of a switch of all the teachers from an affluent school/district/community ("School A") to a poorer school/district/community ("School B").[26] **Table 4** shows select characteristics for the two schools in the 1999-2000 school year. In general, School A's student body is significantly whiter, wealthier, and higher performing, and is taught by teachers with higher degrees and standardized test scores than the student body at School B.

Figure 10 shows the predicted application and certification rates for teachers in Schools A and B, along with the predicted application and certification rates if all of the teachers in School A moved to School B. Given the differences in the characteristics of the teachers and schools and our findings from the application models, one would expect a higher application rate in School A, but the magnitude of that difference is startling. The application rate for teachers in School A is estimated to be 4.02 percent, compared to just .56 percent for teachers in School B. When we simulate the move of School A teachers to School B, School B's application rate rises to .97 percent, indicating that the original difference in application rates between Schools A and B is determined by both teacher and school/community characteristics.

Turning to an examination of certification rates, we predict that School A's applicants would have a certification rate of 73.74 percent, compared to a certification rate of just 19.76 percent for School B's applicants. When we simulate the move of School A teachers to School B, we predict School B's certification rate to be 30.48 percent. This indicates that the difference in certification rates in Schools A and B is estimated to result from both differences in teacher characteristics and differences in school, district, and community characteristics. Thus it is both the characteristics of the teachers as well as the contexts in which they teach that influence NBPTS certification rates.

In our final simulation we are interested in assessing how changes in the incentives offered by localities for teachers to become NBPTS certified might impact the number of NBPTS applicants, the number of NBPTS certified teachers, and the NBPTS-related costs to local school districts and the state as a whole (**Figure 11**). We assess the effects of changes in the teacher salary incentive, but do not simulate the effect of the one-time bonus because the effect was not close to being statistically significant, whereas the district raise was significant at approximately the 19 percent level.

This simulation is somewhat more complex than the others above, since it is necessary to categorize individuals as either having applied for NBPTS certification or not, and having been certified or not, in order to accurately assess the costs to districts and the state as a whole. This is accomplished through a multi-step process. We first calculate the probability of NBPTS application for each teacher in the sample in the year 2000.[27] Based on these individual application probabilities, we categorize teachers as either having applied or not.[28] In the next step, we estimate, for each individual categorized as an applicant, the probability of successful certification. Based on these probabilities, we categorize teachers as being certified or not.[29] Using this process, we can re-estimate application and certification probabilities based on

changes in the salary incentive variable, and re-categorize individuals into one of three categories: non-applicant, non-certified applicant, and certified applicant based on different levels of a NBPTS salary raise. This simulation implicitly assumes that unobservable school, district, and community characteristics are similar across school districts.

The state's predicted cost of NBPTS application is the estimated number of applicants times the $2,300 assessment fee, and is a cost borne solely by the state. The costs associated with successful NBPTS certification are borne by both the state (which pays for a 12 percent salary increase) and by local school districts (which pay the amount specified by the local incentive to all individuals in the district that are certified).[30]

Figure 11 shows the estimated marginal effects of districts offering greater salary incentives on the number of additional NBPTS applicants and certified teachers as well as the associated annual state and local costs.[31] Our baseline simulation estimates show that even in the absence of any local incentives, the state is predicted to have 1,925 NBPTS applicants in the year 2000 and 1,023 teachers who are certified in that year. The predicted cost to the state of in 2000 for those predicted to be certified in that year is estimated to be $8.7 million (approximately $4.4 million for the assessment fee and another $4.3 million for the NBPTS state raises).[32] The predicted ten-year cost to the state (again, without districts offering any additional local incentives) is estimated to be roughly $47 million (consisting of one-time assessment fees and then 12 percent raises for all certified applicants for ten years, the life of the certificate).

The state (and local) costs are estimated to rise significantly in the face of local incentives for NBPTS certification. If, for instance, all districts in the state offered a salary incentive of $1,000 (inducing additional applicants and additional numbers of certified applicants in the state) the cost to the state in that year for those certified in 2000 is estimated to be $10 million (roughly $5 million associated with application fees and $5 million for the raises), and the cost to localities for those certified in 2000 is estimated to be $1.2 million. If instead every district offered an additional $5,000 raise to NBPTS-certified teachers, we estimate there would be 3,090 applicants (or an addition of 1,165 applicants) and 2,076 NBPTS certified teachers (an increase of 1,053 certifications).[33] Interestingly, the certification rate is actually calculated to rise with additional applicants because, using the method described, the additional applicants placed in the applicant group are predicted to have characteristics strongly associated with NBPTS certification.

Aside from looking into the costs associated with various levels of an NBPTS raise, it is also interesting to look at where these costs are borne. For example, the cost to districts in the

state offering a $2,000 increase in salary is roughly $2.8 million for those certified in 2000, while the state cost of districts offering this raise is about $11.2 million. Thus, districts are only paying about 25 percent of the total cost associated with the incentive. However, if districts raise the NBPTS incentive to a $5,000 raise, the local cost rises to about $10 million, while the cost to the state is about $16 million, representing a local cost share of about 60 percent. The reason for this increase in the local share is that the localities pay "economic rents" to those NBPTS certified teachers who would have applied and been certified with a lesser incentive – that is, they are paying a greater salary incentive than is necessary to induce application among many of those who apply and are eventually certified.

VI. Conclusions

In the four-year period from 1997 to 2000, the number of teachers who became NBPTS certified in a single year grew from less than 60 to over 1,000 in the state of North Carolina, reflecting a national trend of increasing numbers of NBPTS certified teachers across the country. This study allows us, for the first time, to speak knowledgeably about the characteristics of teachers, schools and school districts that have exerted the greatest influence on the probability that teachers will apply to NBPTS, and once they apply, the probability of certification. Based on the results, it appears that NBPTS is accurately identifying teachers with stronger academic skills, as measured by their Z-scores. One clear, consistent finding is the strong positive effect of teacher Z-scores on both the likelihood of application and successful NBPTS certification. Though the application rates and certification rates have increased dramatically, there is relatively little evidence to support the notion that lower quality teachers are being encouraged to apply for NBPTS certification, or that it has become easier for teachers to gain certification once they apply.

Certain types of teachers and schools are conspicuously lacking their share of success in the National Board Certification model. We saw from **Table 1** that African-American teachers make up approximately the same percentage in the NBPTS applicant pool as in the teaching workforce as a whole, but they are grossly underrepresented in North Carolina's share of National Board teachers. Even after taking all factors into account, we find that African-American applicants are still nearly 67 percent less likely to obtain NBPTS certification than white applicants. We also find that, all else equal, male teachers are significantly less likely to both apply for and be NBPTS certified than female teachers. The reasons for these differences merit further study.

The fact that teachers are more likely to be certified if they are teaching in more affluent schools and districts with high achieving students contributes to an inequitable distribution of NBPTS certified teachers across students in the state, at least in the short-run. Furthermore, because the state pays $2,300 for every applicant and a 12 percent salary supplement for every NBPTS certified applicant, state money follows NBPTS applicants and certified teachers; if they are concentrated in wealthier schools, this represents a shifting of state resources to more affluent schools and districts.

There are many additional questions about the broader implications of NBPTS. For example, in most school districts, teacher salaries are not differentiated along dimensions other than experience and education levels. Thus, the fact that many states and districts differentiate salaries for NBPTS certified teachers represents a somewhat novel phenomenon. The ramifications of this salary differentiation may be significant, though difficult to assess. One might imagine that it affects both recruitment of new teachers and retention of existing teachers. Economic theory would suggest that individuals considering teaching as a career would be more likely to choose the profession if they could receive the higher salary often associated with NBPTS certification. Thus, we would expect those individuals with characteristics correlated with NBPTS certification success to be more likely to consider the teaching profession. Similarly, the higher wages received by many NBPTS certified teachers would be expected to encourage them to remain in teaching longer than they might otherwise, *ceteris paribus*. Both of these factors could serve to reduce recruitment costs for schools and districts, as they would be faced with lower turnover from the teachers who have traditionally been the most likely candidates for early departure from the teaching profession (those with the highest standardized test scores), as well as greater interest in the field of teaching from similarly qualified individuals who have traditionally been the most difficult to recruit into the school system.

Furthermore, to the degree that NBPTS accurately assesses high quality teachers, NBPTS certification serves as a signal. This signal may be used in the teacher labor market to help districts make recruitment and hiring decisions, and consequently, the NBPTS phenomenon could affect the distribution of teachers across schools and districts. Districts with higher salaries or larger incentives for NBPTS certification may be able to attract a disproportionate share of NBPTS certified teachers. Most importantly, little is currently known about how NBPTS teachers affect students. Nonetheless, a significant amount of research does show a link between measures of teacher academic skills and student outcomes. Thus, our finding of a positive correlation between teacher Z-scores and NBPTS certification provides indirect evidence that the

National Board is certifying teachers likely to be effective as measured by student outcomes. There may also be broader student achievement impacts of NBPTS certification as it is hoped that NBPTS teachers will serve as role models and mentors for new teachers, take on greater leadership roles, share effective teaching methods with colleagues, and improve the learning environment in schools.

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References

American Council on Education (1999). *To Touch the Future: Transforming the Way Teachers are Taught*. A report prepared by the ACE Presidents' Task Force Report on Teacher Education.

American Federation of Teachers (2000). Press Release: Statement by AFT president on Unprecedented Number of National Board Certified Teachers. November 30, 2000.

Ballou, Dale and Michael Podgursky, (1998), "The case against teacher certification." *The Public Interest,* no.132, 17–29.

Carnegie Forum on Education and the Economy (1986), *A Nation Prepared: Teachers for the 21st Century.* The Report of the Task Force on Teaching as a Profession. New York.

Darling-Hammond, Linda (2000), "Teacher Quality and Student Achievement: A Review of State Policy Evidence." *Education Policy Analysis Archives*, 8(1): http://olam.ed.asu.edu/epaa/v8n1.

Darling-Hammond, Linda, Barnett Berry, and Amy Thoreson (2001), "Does Teacher Certification Matter? Evaluating the Evidence" *Educational Evaluation and Policy Analysis*), 23: 57-77.

Ehrenberg, Ronald G., and Dominic J. Brewer (1994). "Do School and Teacher Characteristics Matter? Evidence from High School and Beyond." *Economics of Education Review*, 13(1).

Ferguson, Ronald F. (1991). "Paying for Public Education: New Evidence on How and Why Money Matters." *Harvard Journal on Legislation*, 28(2).

Ferguson, Ronald (1998)., "Teachers' perceptions and expectations and the Black-White test score gap.." In C. Jencks and M. Phillips (Eds.), *The Black-White test score gap* (pp. 273–317). Washington, DC: Brookings Institution Press.

Goldhaber, Dan D., and Dominic J. Brewer (1997), "Why Don't Schools and Teachers Seem to Matter? Assessing the Impact of Unobservables on Educational Productivity." *Journal of Human Resources*, 32(3): 505-523.

Goldhaber, Dan D., and Dominic J. Brewer (2000), "Does Teacher Certification Matter? High School Teacher Certification Status and Student Achievement." *Educational Evaluation and Policy Analysis*, 22: 129-145.

Goldhaber, Dan D., and Dominic J. Brewer (2001), "Evaluating the Evidence on Teacher Certification: A Rejoinder." *Educational Evaluation and Policy Analysis*, 23: 79-86.

Goldhaber, Dan (2002). "The Mystery of Good Teaching: Surveying the Evidence on Student Achievement and Teachers' Characteristics." *Education Next,* 2(1): 50-55.

Greenwald, Rob, Larry Hedges, and Richard Laine (1996), "The Effect of School Resources on Student Achievement." *Review of Educational Research*, 66(3): 361-396.

Hanushek, Eric A. (1986), "The Economics of Schooling: Production and Efficiency in the Public Schools." *Journal of Economic Literature*, XXIV (3): 1141-78.

Hanushek, Eric A. (1997), "Assessing the Effects of School Resources on Student Performance: An Update." *Educational Evaluation and Policy Analysis*, 19(2), Summer.

National Commission on Teaching and America's Future (1996), *What Matters Most: Teaching for America's Future*, New York.

Porter, Andrew C., Peter Youngs, Allen Odden (2000). Advances in Teacher Assessments and Their Uses. Virginia Richardson, Ed. *Handbook of Research on Teaching, Second Edition*. New York: Macmillan.

Strauss, R. P., & Sawyer, E. A. (1986), "Some New Evidence on Teacher and Student Competencies. "*Economics of Education Review, 5*(1), 41–48.

Sullivan, Cheryl C. (2001), "Into the Classroom: Teacher Preparation, Licensure, and Recruitment." *National School Boards Association.* Alexandria, VA.

Wilcox, Danielle. D. (1999). "The National Board of Professional Teacher Standards: Can it live up to its promise?" In *Better Teachers, Better Schools*. Edited by Marci Kanstoroom and Chester E. Finn, Jr. Washington, DC: The Thomas B. Fordham Foundation.

Endnotes

[1] These calculations assume that there is an annual two percent inflation rate every year and that NBPTS certified teachers stay in the same district for the ten year life of the certificate.
[2] The cohort certification rates for 1997, 1998, 1999, and 2000 are 55.8, 67.5, 63.3, and 52.2 respectively.
[3] Various aspects of the NBPTS process have evolved, and continue to evolve, since NBPTS first began to certify teachers. All references to the NBPTS assessment process refer to the process utilized in 2000 to ensure that we accurately describe what the teachers in our study would have experienced in applying for NBPTS certification.
[4] The exclusion of teachers with less than three years of experience reduces the sample by 46,635 teachers. We also restrict the sample to teachers who have not been previously NBPTS certified because these teachers are unable to apply for certification again.
[5] We know that the North Carolina variable of years of experience is not a perfect measure of years of teaching experience because teachers are credited with experience on a case-by-case basis and according to N.C. teacher requirements established by the Department of Pubic Instruction. We actually lose 75 teachers from our sample who did apply to NBPTS, so they presumably had three years of teaching experience or more, but due to state education standards for teachers and salary guidelines, they were credited by the state with less experience. There are other inconsistencies between NBPTS' requirements for years of teaching experience and North Carolina's years of teaching experience. For instance, NBPTS requires teachers to have three years of classroom experience as the primary teacher, as opposed to being a teacher's aid, before the year in which they apply for certification, while North Carolina may credit teachers with years of experience for non-teaching jobs that may be subject-related experience. However, all of our results are broadly consistent for the various sub-samples of teachers.
[6] NBPTS certification tends to be announced in the fall/winter of the year following application, so teachers certified in the fall/winter of 1998 have their NBPTS record attached to their 1997-1998 school year state record.
[7] Consider, for example, a teacher who does not apply for certification in 1997, applies for the first time in 1998 and fails to obtain certification, applies again in 1999 and successfully obtains certification, and remains employed in North Carolina in 2000. That teacher's 1997, 1998, and 1999 records will be included in the full sample, but his/her 2000 records will be excluded from this sample. That teacher's 1998 and 1999 records will be included in the applicant sample, but his/her 1997 and 2000 records will be excluded from this sample.
[8] For complete list and explanation of the variables, see **Appendix A**.
[9] The estimated coefficients from these models can be used in a straightforward transformation to yield an interpretation similar to familiar statistical techniques such as Ordinary Least Squares.
[10] We created one dummy variable for each year of our data (1997-2000), and set those variables equal to one if the teacher's record corresponded with each particular year, and zero if it did not. For example, if a teacher taught in North Carolina in 1997 and 1998, that teacher's 1997 record would have a 1997 dummy variable equal to one, and 1998, 1999, and 2000 dummy variables equal to zero. That same teacher's 1998 record would have a 1998 dummy variable equal to one, and 1997, 1999, and 2000 dummy variables equal to zero. These year dummy variables were then multiplied by the teacher Z-score to create the interaction terms.
[11] Specifically, the peer effects variables represent, for each individual, the number of teachers, excluding that particular individual, in that individual's school and district, who are current NBPTS applicants, previously successful applicants (NBPTS certified teachers), and previously unsuccessful applicants.

[12] Part of the explanation for the rising certification rate may be the fact that the National Board began allowing the "banking" of scores. In 1996-97, NBPTS allowed applicants who were unsuccessful on the NBPTS assessment as a whole to retain or "bank" portions of the assessment (on which they scored sufficiently high) such that they need not retake that portion of the assessment. Beginning with the 2000-2001 cycle, all first-time National Board Certification candidates may bank individual exercises and retake scores for a period of two subsequent, consecutive years from the date of initial score notification. During this two-year period, candidates who did not achieve certification during their initial attempt may retake any combination of portfolio entries and/or assessment center exercises in the assessment package on which they did not meet the individual entry/exercise performance standard. A substantial number of applicants (19 percent) had previously tried for NBPTS certification and were reapplying. Certification rates for NBPTS applicants who have previously applied to NBPTS are slightly lower (47 percent compared to a certification rate of 49 percent of first-time NBPTS applicants) and NBPTS assessment scores were lower as well (269 points compared to a mean score of 271 for first-time NBPTS applicants). Our regressions included a control variable for whether or not that candidate was reapplying.

[13] This and other district incentive means discussed in this paragraph and displayed in **Table 2** are based on district observations in districts offering either a NBPTS bonus or a raise to NBPTS certified teachers.

[14] Unfortunately, there are too few NBPTS applicants per school to allow estimation of school level fixed-effects models.

[15] Despite the similarity of the coefficients, log likelihood tests suggests the fixed-effects specification to be the preferred model specification for the application models.

[16] Given that these results are consistent in both the base models and the district fixed effects models, we can rule out the possibility that the effects simply reflect the impacts of unobserved district factors.

[17] For a discussion of the impact of teacher degree level on student outcomes, see Goldhaber and Brewer (1997), Hanushek (1986, 1997), and Sullivan (2001). For a discussion of the impact of teacher licensure on student outcomes, see Darling-Hammond (2000), Darling-Hammond et al. (2001), and Goldhaber and Brewer (2000, 2001).

[18] This variable is actually the average teacher performance on a variety of tests available for each teacher including teacher licensure tests, the SAT, etc. For more information on this variable see **Appendix A**.

[19] For a review of the evidence on the effects of various teacher characteristics on student outcomes, see Goldhaber (2002), Greenwald et al. (1996), Hanushek (1986, 1997), and Sullivan (2001).

[20] We do not report the coefficient estimates for the models that do not include these variables, but they are available from the authors upon request. The peer effects variables are the number of other NBPTS applicants, NBPTS certified teachers and past unsuccessful NBPTS applicants in that school or district. These and other variables are defined in **Appendix A**.

[21] Again, we see that the coefficient estimates in our base logit model (column 3) are remarkably similar to the model that includes the district fixed-effects (column 4). However, we again find that the fixed effects model is the preferred specification for the certification models by the log likelihood test.

[22] None of the district peer effects variables (the number of teachers in the district applying to NBPTS, the number of successful NBPTS certifications in the district and the number of unsuccessful NBPTS applicants) appear to impact the likelihood of successful certification.

[23] We observe that district incentive variables do not appear to influence the probability of NBPTS certification. We might have, *a priori*, expected that districts that are extremely supportive of NBPTS are likely to both provide financial incentives for teachers to obtain certification as well as other supports that might enhance the likelihood of application and success. These unobserved effects could upwardly bias our estimates of the impact of the financial incentive variables. Thus, the fact that the incentive variables are not significant in the probability of certification models is somewhat reassuring.

[24] The 1998 NBPTS Assessment scores are statistically significant at the 10 percent level and subsequent years are more significant.

[25] These results are available from the authors upon request.

[26] The example is based on the characteristics of two actual high schools from North Carolina.

[27] The probability is calculated based on our estimated coefficients from the plain logistic regression application and certification models (columns 1 and 3 of **Table 3**).

[28] This categorization is accomplished by assigning a random number between zero and one to each individual. If the probability that they apply exceeds the random number, then they are categorized as having applied, if their probability does not exceed the random number, they are categorized as non-applicants.

[29] The process used for this categorization parallels that used for the categorization at the application stage.

[30] Our estimate of state cost is actually slightly inflated because we calculate the 12 percent raise based on teachers' actual salary, which in some districts is higher than the state salary scale. The state however, only pays a 12 percent raise based on the state salary scale rather than possible higher actual salaries.

[31] The salary cost is based on individual teachers' 10-month teacher contract.

[32] These costs are actually lower-bound because they do not include any adjustment in salary for inflation.

[33] It is important to note that it is possible that the effect of incentive is overstated. For example, NBPTS applicants may be focused on the long-term career benefits (both financial and otherwise) of NBPTS certification. Prospective NBPTS candidates may seek certification in districts that offer raises with the intention of eventually moving to another district. It is necessary to gain a greater understanding of teachers' career paths to be more confident that our estimates reflect the true effects of these incentives.

Tables and Figures

1

Table 1. Select Teacher, School, District and Community Characteristics by Application Status

(Standard deviations in parentheses)

	Overall Sample	Did Not Apply	Applied	Applied, Not Certified	Applied, Certified
TEACHER CHARACTERISTICS					
Age	48.84 (9.46)	48.87 (9.46)	41.72 (8.81)	42.05 (8.78)	41.61 (8.72)
Black	.14 (.35)	.14 (.35)	.13 (.34)	.22 (.41)	.04 (.20)
White	.84 (.36)	.84 (.36)	.85 (.36)	.76 (.43)	.94 (.23)
Hispanic	.00 (.07)	.00 (.07)	.00 (.04)	.00 (.04)	.00 (.05)
Asian	.00 (.05)	.00 (.05)	.00 (.06)	.00 (.05)	.00 (.06)
Male	.18 (.39)	.18 (.39)	.09 (.29)	.09 (.29)	.09 (.29)
Female	.82 (.37)	.82 (.39)	.91 (.29)	.91 (.29)	.91 (.29)
Individual 10 Month Salary ($)	3311.50 (579.93)	3310.34 (580.60)	3378.47 (535.14)	3345.94 (530.01)	3413.03 (538.51)
Years of Teaching Experience	15.63 (8.74)	15.66 (8.76)	14.02 (7.78)	13.77 (7.77)	14.28 (7.79)
Teacher Z-score	-.03 (.93)	-.03 (.93)	.17 (.90)	-.10 (.89)	.46 (.82)
NBPTS Final Assessment Score	N/A	N/A	270.87 (40.19)	240.56 (29.04)	302.21 (21.95)
Permanent Status of Teaching License	.95 (.22)	.95 (.23)	1.00 (.06)	1.00 (.07)	1.00 (.06)
North Carolina Based License	.71 (.45)	.71 (.45)	.80 (.40)	.82 (.38)	.78 (.41)
Endorsed License	.23 (.42)	.23 (.42)	.23 (.42)	.20 (.40)	.26 (.44)
Vocational License	.05 (.22)	.05 (.22)	.02 (.14)	.02 (.13)	.02 (.15)
Master's Degree	.28 (.45)	.28 (.45)	.43 (.49)	.39 (.49)	.46 (.50)
SCHOOL CHARACTERISTICS					
Students Performing At or Above Grade-Level	.71 (.12)	.71 (.11)	.72 (.12)	.70 (.13)	.73 (.11)
Students Exceeding Expected Performance	.53 (.50)	.53 (.50)	.56 (.50)	.51 (.50)	.60 (.49)
Minority Students	.37 (.24)	.37 (.24)	.37 (.24)	.40 (.26)	.33 (.22)
Student/Teacher Ratio	14.49 (5.66)	14.48 (5.68)	14.84 (4.20)	14.74 (4.93)	14.94 (3.25)

Table 1 cont. Select Teacher, School, District and Community Characteristics by Application Status

(Standard deviations in parentheses)

	Overall Sample	Did Not Apply	Applied	Applied, Not Certified	Applied, Certified
Free-Lunch Students	.31 (.19)	.31 (.19)	.31 (.19)	.34 (.20)	.28 (.18)
DISTRICT AND COMMUNITY CHARACTERISTICS					
Bonus Incentive ($)[a]	15.30 (91.90) 525.04 (148.84)	15.07 (91.17) 524.62 (148.71)	28.90 (126.35) 538.16 (152.48)	28.17 (127.34) 554.95 (165.00)	29.67 (125.31) 522.22 (138.41)
% In Districts with Bonus Incentive	2.91 (16.82)	2.87 (16.70)	5.37 (22.54)	5.08 (21.95)	5.68 (23.16)
Salary Incentive (Raise) ($)[a]	33.05 (223.75) 825.99 (772.14)	3260 (221.71) 818.41 (768.82)	59.41 (319.91) 1173.25 (846.87)	54.61 (307.65) 1137.48 (863.61)	64.50 (332.44) 1207.39 (833.09)
% In Districts with Salary Increment Incentive	4.00 (19.60)	3.98 (19.56)	5.06 (21.93)	4.80 (21.38)	5.34 (22.49)
% In Districts with NBPTS Financial Incentives	6.14 (24.01)	6.08 (23.90)	9.70 (29.60)	9.24 (29.96)	10.20 (30.27)
Current Per Pupil Expenditure ($)	5415.08 (569.96)	5411.95 (569.66)	5597.17 (557.48)	5642.74 (556.27)	5554.27 (555.35)
Rural District	.36 (48)	.36 (.48)	.33 (.47)	.36 (.48)	.30 (.46)
Urban District	.17 (.38)	.17 (.38)	.20 (.40)	.18 (.38)	.22 (.41)
Starting Salary w/ Bachelor's Degree ($)	23274.50 (1364.94)	23262.57 (1364.67)	23963.27 (1193.56)	23840.75 (1184.23)	24097.74 (1189.59)
% Children in Poverty	14.87 (7.52)	14.88 (7.52)	14.65 (7.63)	15.47 (8.20)	13.78 (6.87)
% Minority Children	22.67 (18.67)	22.69 (18.68)	21.78 (18.15)	24.17 (19.63)	19.23 (16.04)
% Bachelor's or Higher Degree in Community	17.34 (11.50)	17.34 (11.48)	17.26 (11.89)	15.95 (11.30)	18.65 (12.35)
Median Housing Value ($)	66530.37 (16886.61)	66541.17 (16894.93)	67175.09 (16831.86)	65064.40 (16254.66)	69418.99 (17145.78)
N	251567	247321	4246	2187	2059

[a] Numbers appearing above the diagonal line are means for all districts, while the numbers appearing below the diagonal line represent the means for only districts with the specified incentive.

Table 2. District Means between Districts w/o Incentives, Districts w/ Bonus, Districts w/ Salary Increment
(Standard deviations in parentheses)

	District w/o Incentive	Bonus	Salary Increment (Raise)
Bonus Incentive ($)	N/A	494.44 (147.42)	133.33 (228.87)
Salary Incentive (Raise) ($)	N/A	111.11 (213.90)	768.47 (684.87)
Current Per Pupil Expenditure	5600.27 (725.16)	5528.91 (577.22)	5281.91 (497.90)
Total PK-12 Students in District	9525.73 (14499.22)	7960.17 (4865.57)	13478.60 (6239.54)
Starting Salary with Bachelor's Degree ($)	22929.28 (1180.84)	23529.28 (1030.78)	23416.13 (1075.45)
% Children in Poverty in Community	17.57 (9.48)	14.47 (5.82)	14.97 (5.85)
% Minority Children in Community	25.71 (21.80)	23.36 (9.29)	24.73 (18.77)
% Bachelor's or Higher Degree in Community	12.48 (8.85)	11.61 (3.92)	13.03 (4.04)
Median Value Housing ($)	57282.83 (14326.15)	59037.11 (8041.42)	63582.47 (10322.74)
Total Number of Districts	106	7	4

Table 3. Marginal Probability of Application and Certification, Linear Estimates of NBPTS Assessment Score [a-d]

(Standard errors in parentheses)

	1	2	3	4	5	6
	Application		Certification		NBPTS Assessment Score	
MODEL SPECIFICATION	Base	District Fixed-Effects	Base	District Fixed-Effects	Base	District Fixed-Effects
Age	-.03*** (.00)	-.03*** (.00)	-1.17*** (.15)	-1.28*** (.16)	-.91*** (.09)	-.95*** (.09)
Black	.40*** (.10)	.41*** (.10)	-32.77*** (3.40)	-33.12*** (3.50)	-25.39*** (1.83)	-24.94*** (1.86)
Hispanic	-.73 (.61)	-.72 (.61)	21.39 (20.00)	28.07 (20.27)	9.89 (12.20)	4.68 (9.61)
Asian	.74 (.50)	.73 (.50)	22.62 (16.08)	30.11* (16.98)	-3.07 (9.61)	13.74 (12.20)
Male	-1.28*** (0.10)	-1.28*** (0.10)	-13.77*** (3.04)	-14.50*** (3.14)	-13.49*** (1.92)	-14.00*** (1.93)
Individual 10 Month Salary($)	.81*** (.21)	.80 *** (.21)	-.81 (5.57)	-.03 (5.66)	2.81 (3.56)	2.89 (3.53)
Teacher Z-Score	.41*** (.16)	.40*** (.16)	22.17*** (7.01)	21.49*** (7.14)	24.01*** (3.53)	22.90*** (3.52)
Permanent Status of Teaching License	3.97*** (.41)	3.98*** (.41)	-1.60 (14.54)	-.27 (14.86)	-2.22 (8.70)	.42 (8.71)
North Carolina Based License	.40*** (.07)	.39*** (.07)	-.39 (2.21)	-0.35 (2.29)	1.41 (1.39)	1.04 (1.41)
Years of Teaching Experience	-.09*** (.01)	-.09*** (.01)	1.08** (.38)	1.10*** (.39)	0.50** (.24)	0.50** (.24)
Master's Degree	1.00*** (.07)	1.01*** (.07)	6.65*** (2.12)	6.36*** (2.19)	6.68*** (1.34)	6.31*** (1.34)
Ph.D. or Other Advanced Degree	.90*** (.22)	.91*** (.22)	8.12 (6.58)	5.55 (6.76)	7.86* (4.16)	6.73 (4.17)
Prior Application to NBPTS	7.06*** (.10)	7.06*** (.11)	2.79 (2.33)	4.31* (2.38)	0.42 (1.47)	0.45 (1.47)
1998	2.23*** (.18)	2.33*** (.17)	2.95 (6.42)	-.52 (6.20)	3.96 (3.67)	3.60 (3.46)
1999	2.69*** (.21)	2.90*** (.18)	6.78 (7.18)	7.87 (6.30)	5.98 (4.20)	8.76** (3.56)
2000	2.81*** (.25)	2.97*** (.19)	12.23 (8.22)	14.94** (6.66)	10.16** (4.92)	14.59*** (3.81)
1998 *Teacher Z-Score	.16 (.18)	.17 (.18)	-1.71 (7.48)	-.79 (7.64)	-7.79** (3.78)	-6.83* (3.78)
1999 *Teacher Z-Score	.16 (.17)	.18 (.17)	-6.83 (7.21)	-5.49 (7.36)	-11.03*** (3.65)	-9.81*** (3.65)
2000 *Teacher Z-Score	-.07 (.17)	-.06 (.17)	-7.39 (7.16)	-5.71 (7.31)	-11.85*** (3.62)	-10.47*** (3.62)
Other Current Applicants in School	.54*** (.02)	.54*** (.02)	.61 (.51)	0.54 (0.53)	0.25 (0.32)	0.12 (0.33)
Other Previous NBPTS certified Teachers in School	.13*** (.04)	.08** (.04)	2.87*** (1.05)	.91 (1.08)	2.07*** (0.65)	0.85 (0.65)
Other Previous Unsuccessful NBPTS Applicants in School	-.28*** (.04)	-.33*** (.04)	-2.19* (1.19)	-1.41 (1.16)	-1.00 (0.71)	-0.53 (0.71)

Total Students in School	-.70*** (.09)	-.62*** (.10)	-.19 (2.68)	-.29 (2.84)	1.40 (1.68)	1.92 (1.73)
Minority Students in School	.40*** (0.21)	.16 (0.25)	-6.59 (6.47)	-6.43 (8.08)	-8.40** (4.02)	-10.10** (4.82)
Student/Teacher Ratio in School	.00 (.00)	.00 (.00)	.00 (.21)	.03 (.22)	.02 (.13)	.07 (.13)
Students on Free-Lunch Program	-.65** (.25)	-.56** (.27)	-16.07** (8.06)	-21.98** (8.80)	-7.36 (4.87)	-8.85* (5.19)
Other Current NBPTS Applicants in District	.02*** (.00)	-	-.09 (.08)	-	-.08 (.05)	-
Other Current NBPTS certified Teachers in District	-.01 (.00)	-	-.14 (.11)	-	-.06 (.07)	-
Other unsuccessful applicants in district	-.02*** (.01)	-	.28 (.22)	-	.20 (.14)	-
Bonus Incentive ($)	.03 (.25)	-	-.46 (7.09)	-	3.62 (4.56)	-
Salary Incentive (Raise) ($)	.20 (.10)	-	3.77 (2.84)	-	2.24 (1.82)	-
Total PK-12 Students in District	-.01*** (.00)	-	.06 (.10)	-	.07 (.06)	-
Current Per Pupil Expenditures ($)	-.02 (.08)	-	3.10 (2.62)	-	2.77* (1.62)	-
Urban District	.25*** (.12)	-	2.40 (3.53)	-	1.43 (2.23)	-
Suburban District	.09 (.08)	-	-3.41 (2.50)	-	-2.77* (1.57)	-
% Education Expenditures Spent on Instruction	-.01 (.01)	-	-1.16** (.56)	-	-.77*** (.35)	-
Starting Salary with Bachelor's Degree ($)	.00 (.05)	-	1.54 (1.39)	-	.66 (.87)	-
% Children in Poverty in District	.01 (.01)	-	-.09 (.16)	-	-.20** (.10)	-
% Minority Children in District	.00 (.00)	-	-.08 (.07)	-	-.05 (.05)	-
% with Bachelor's or Higher Degree in Community	-.01*** (.00)	-	.21 (.19)	-	-.01 (.12)	-
Median Housing Value in Community	.01*** (.00)	-	.12 (.13)	-	.20** (.08)	-
N	251567[c]	251567 [c]	4246	4246	4188[d]	4188 [d]

*** p < .01 ** p < .05 * p < .10

[a] These marginal probabilities (and standard errors) are obtained from the logistic coefficients by multiplying the logistic coefficients by P(1-P).

[b] Beta estimates and standard errors are multiplied by 100 in columns 1-4 to show the effects in percentage points.

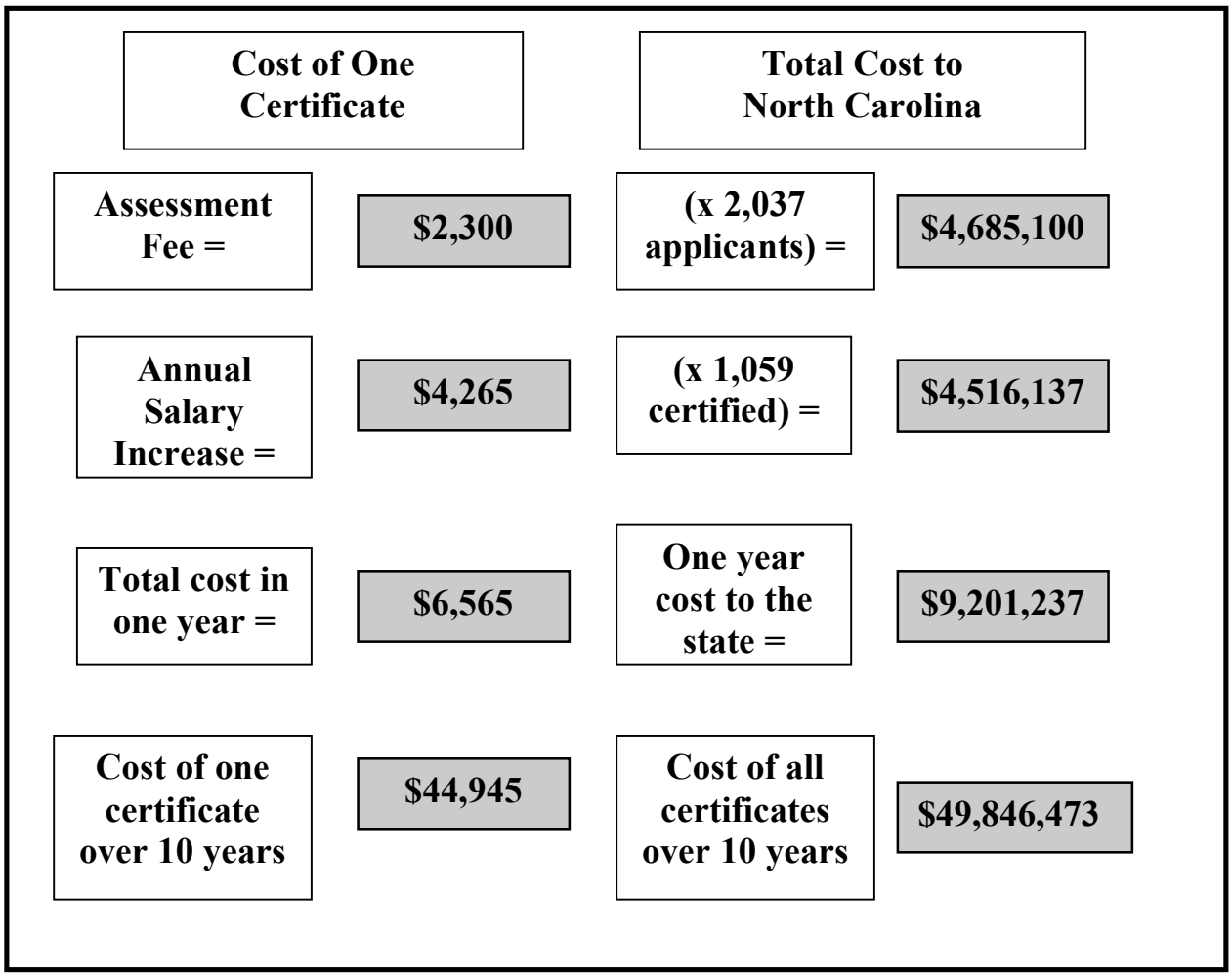
[c] This is the number of teachers in the state that had at least three years of teaching experience and who were not previously NBPTS certified so were qualified to apply to NBPTS that year.

[d] This is the number of teacher records for whom we have their actual NBPTS assessment score.

Table 4. Select Characteristics: Advantaged High School vs. Disadvantaged High School in 2000

Variable	Advantaged High School (School A)	Disadvantaged High School (School B)
Teacher Characteristics		
% Black	10.4%	30.1%
Teacher Z-Score	0.19	-0.40
% with Master's Degree	40%	11%
School Characteristics		
% Students Performing At or Above Grade-Level	78.2%	43.5%
% Minority Students	24%	70%
% Free-Lunch Students	10%	30%
Community Characteristics		
% Children in Poverty	13.1%	29.4%
% Bachelor's or Higher Degree	30.8%	7.7%
Median Housing Value ($)	$86,348	$45,488

Figure 1. Estimated Cost to North Carolina for Application and Certification in 2000[a]



[a] These estimates are actually lower-bound because they do not include annual inflation. These cost estimates of one year and ten year costs to North Carolina only take into account the teachers who apply and those who become certified in 2000, and not the amount associated with the 12 percent raise paid to teachers certified in previous years. North Carolina actually spent approximately $16,452,999 in 2000 on NBPTS to cover all associated costs, including the $6,060,948 in pay increases to teachers certified earlier than 2000.

Figure 2. Increase in the Number of National Board Applicants, Number of Certified Teachers, and Certification Rates in North Carolina

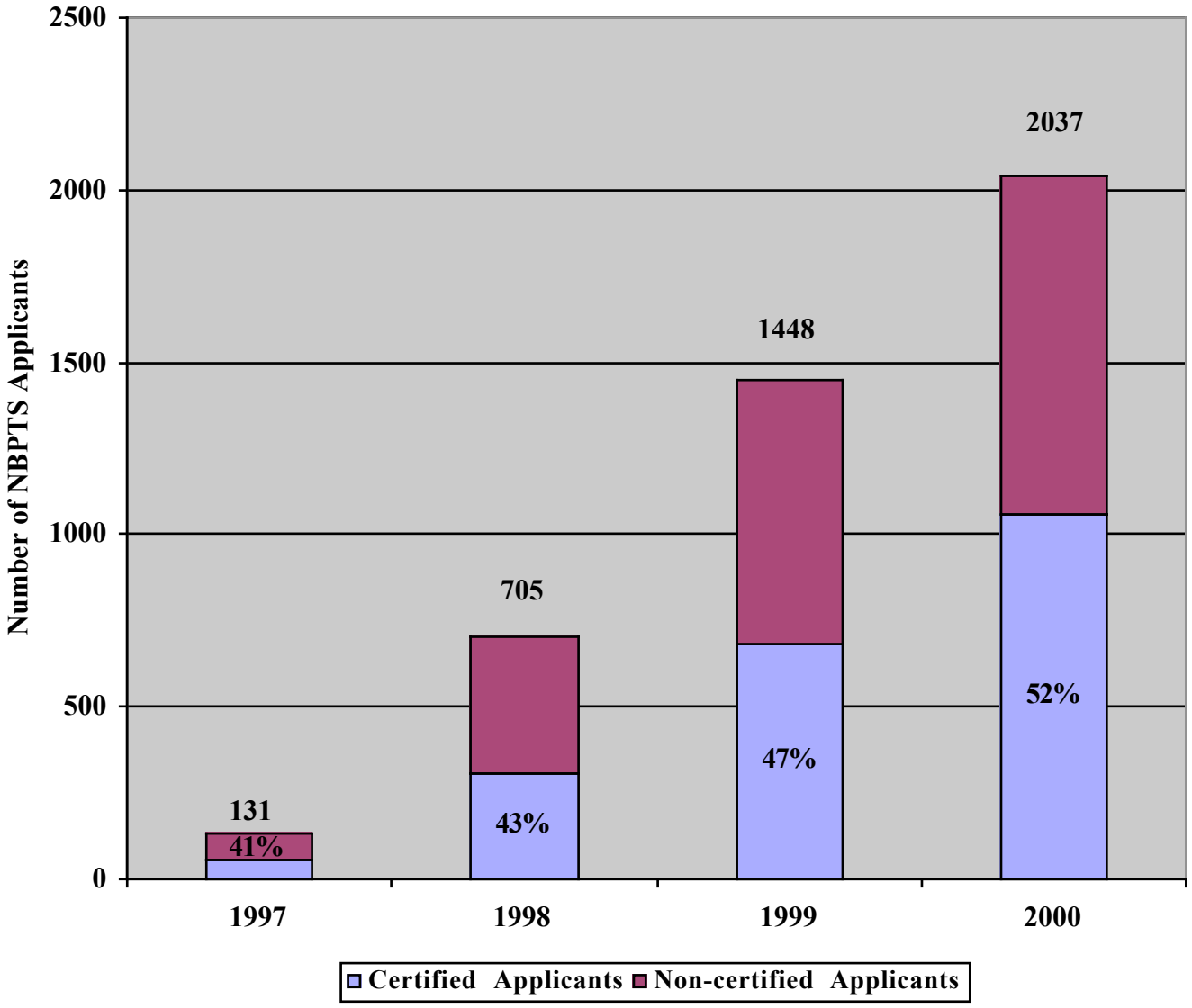


Figure 3. National Board Certification Areas of Certified North Carolina Applicants from 1997-2000

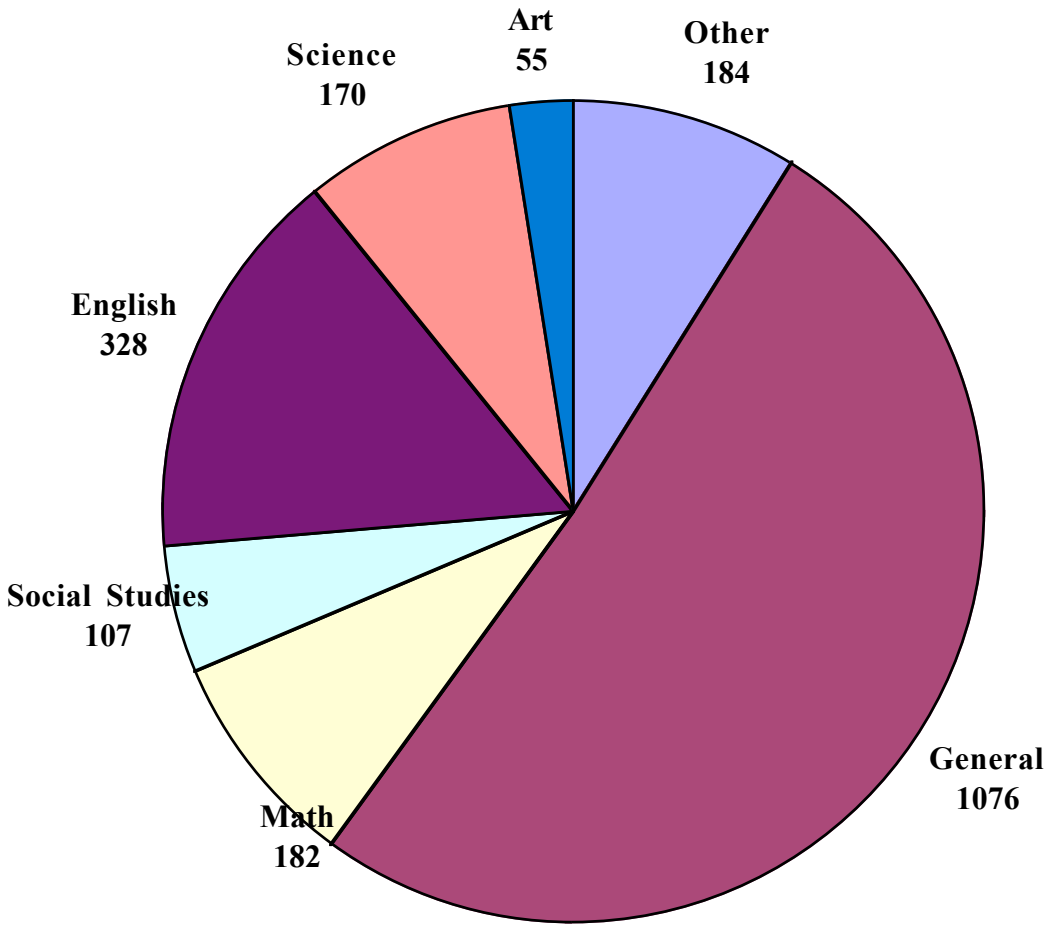


Figure 4. Application Rates for Teacher with 1997 Mean Characteristics

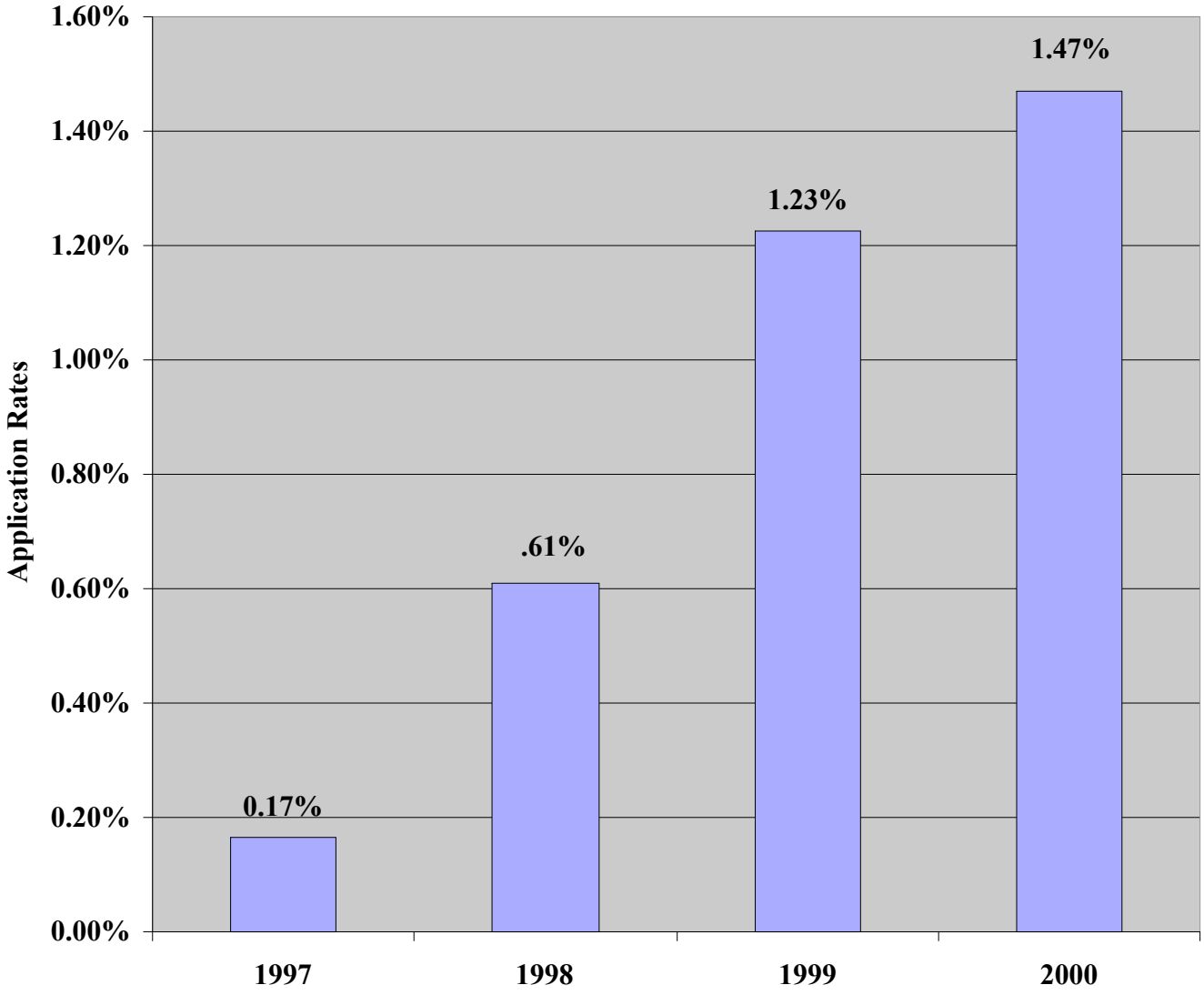


Figure 5. Certification Rates for Teacher with 1997 Characteristics

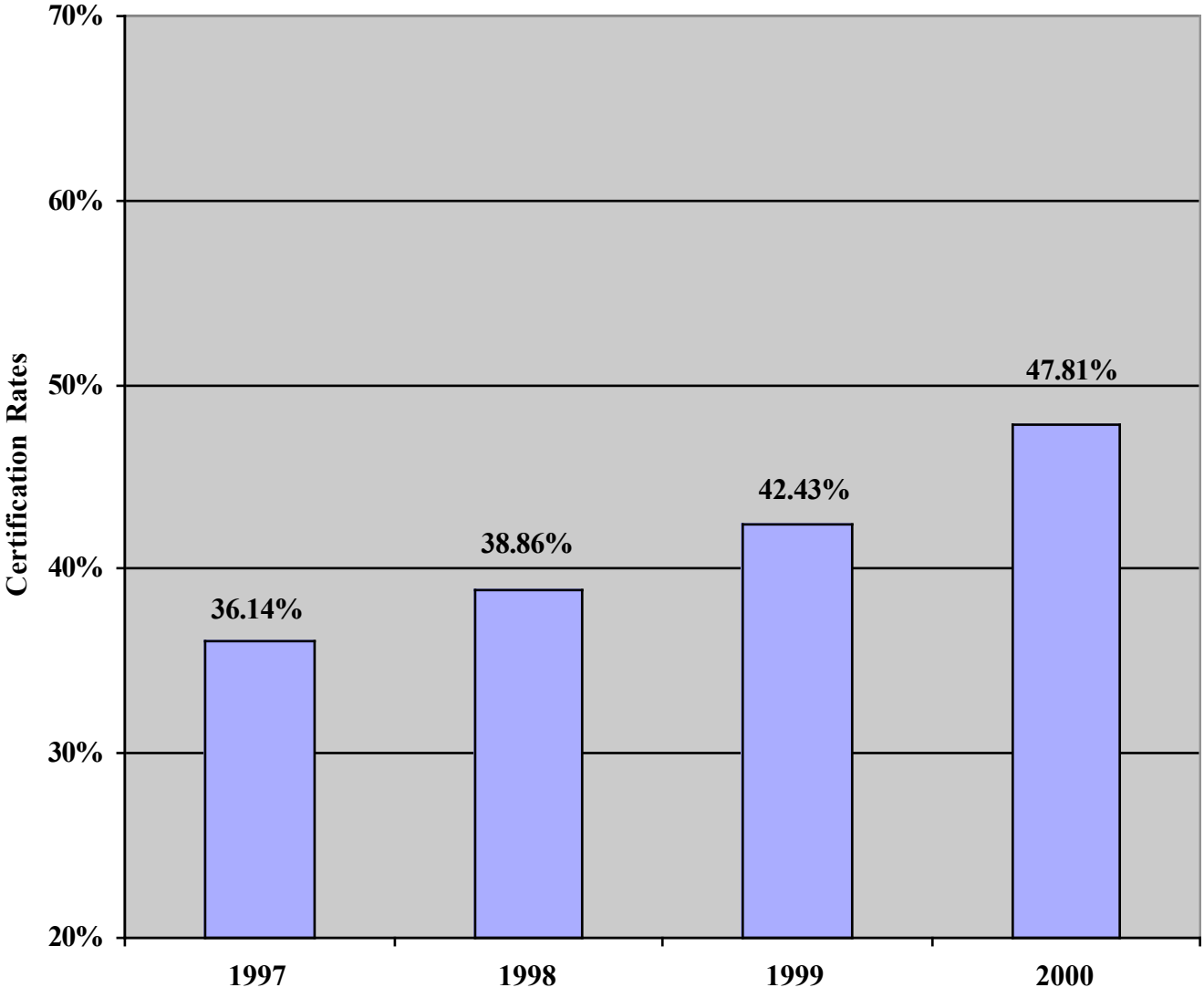


Figure 6. NBPTS Assessment Score for Individual with 1997 Characteristics

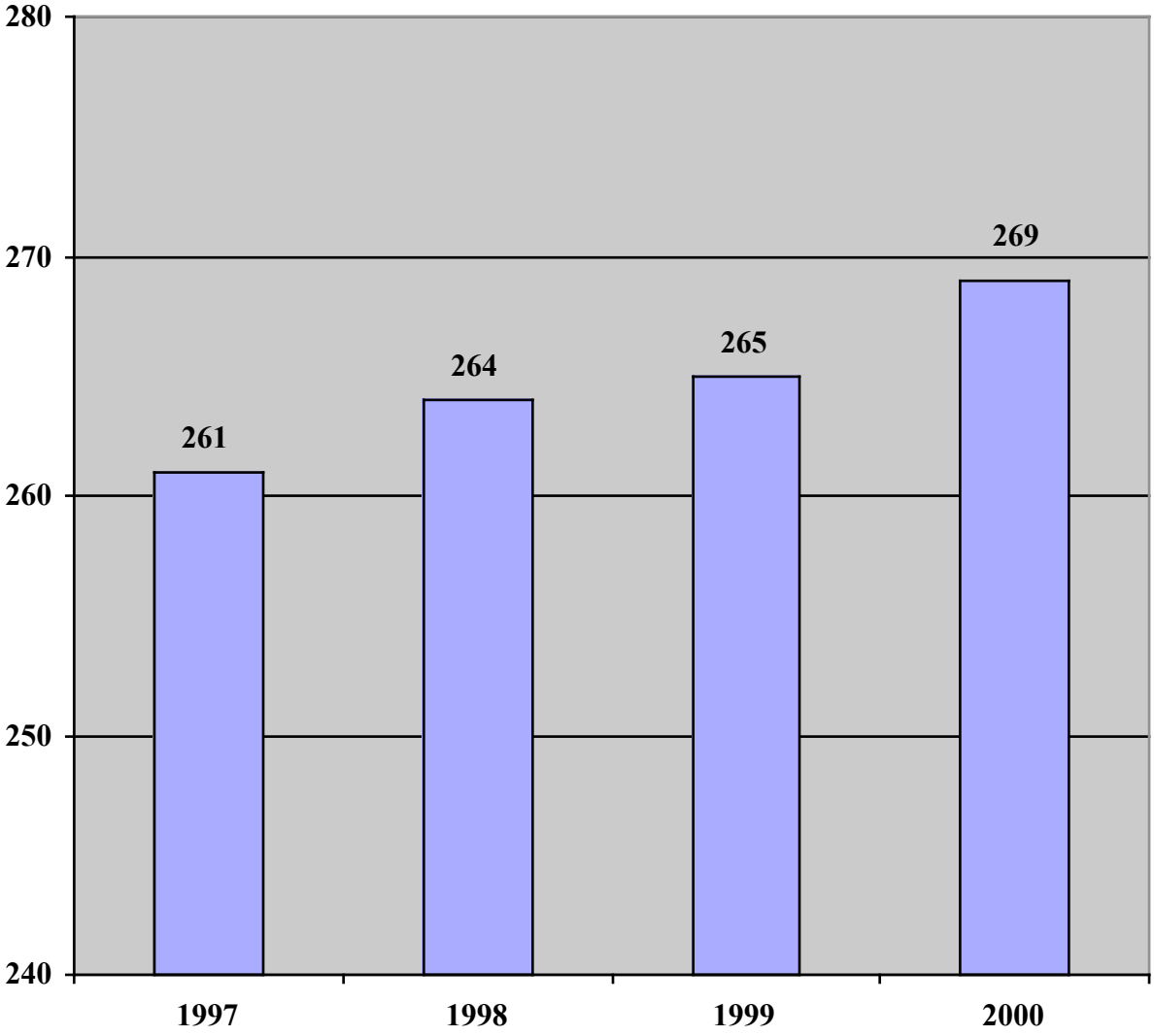


Figure 7. Simulated Application Rates by Teacher Test Z-score and Year

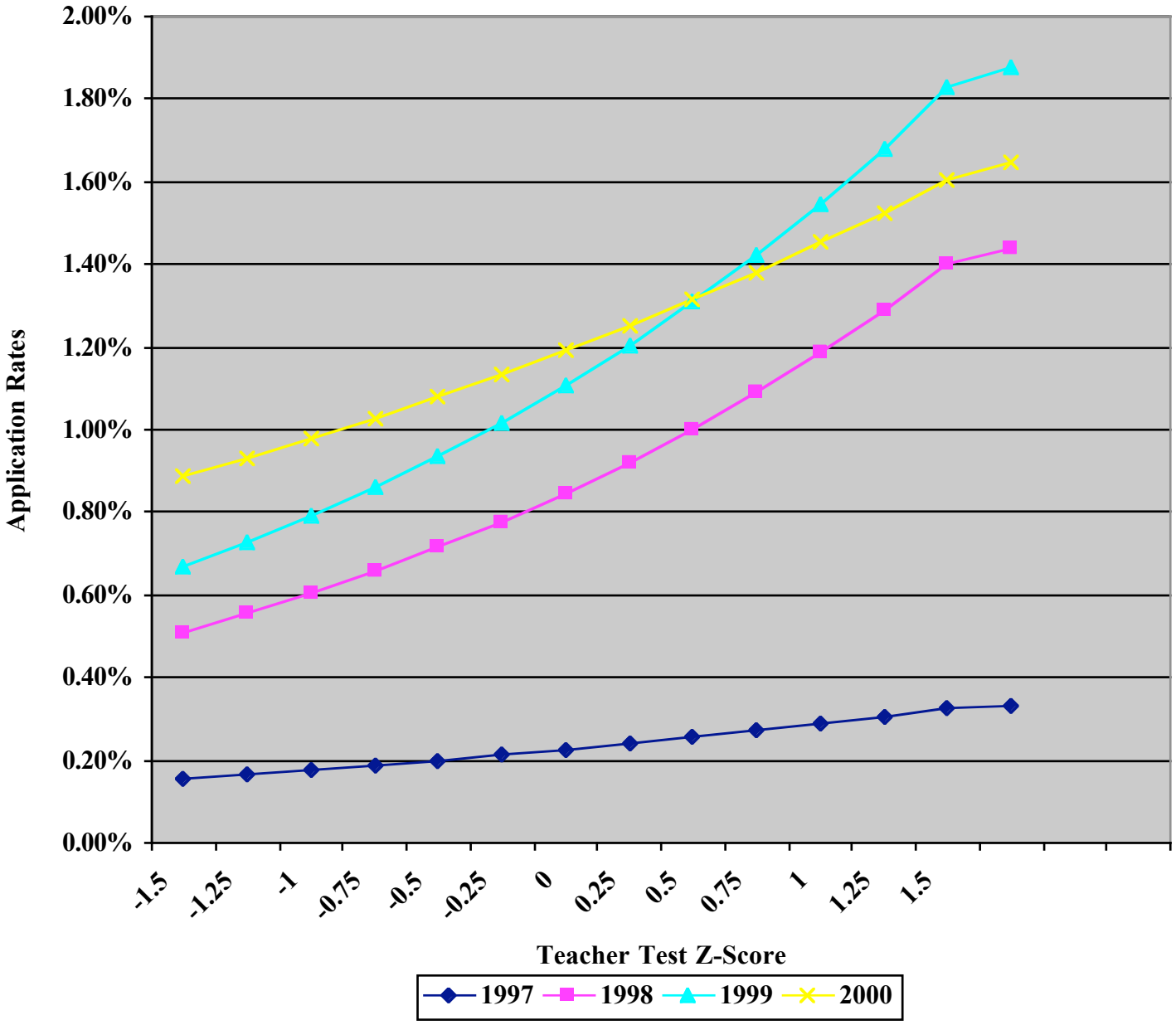


Figure 8. Simulated Conditional Certification Rate by Teacher Z-score and Year

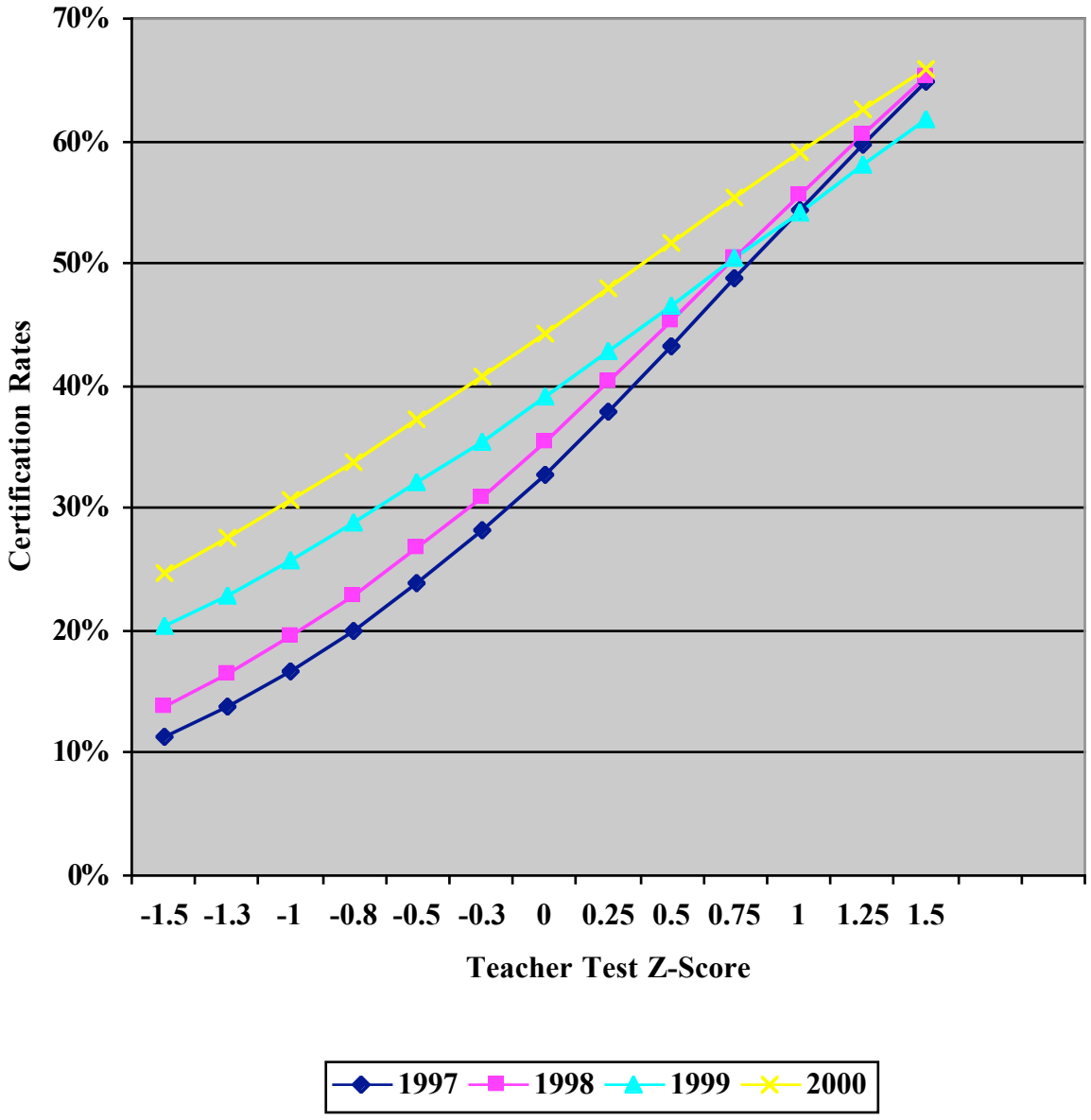


Figure 9. Simulated NBPTS Assessment Score by Teacher Z-score and Year Figure

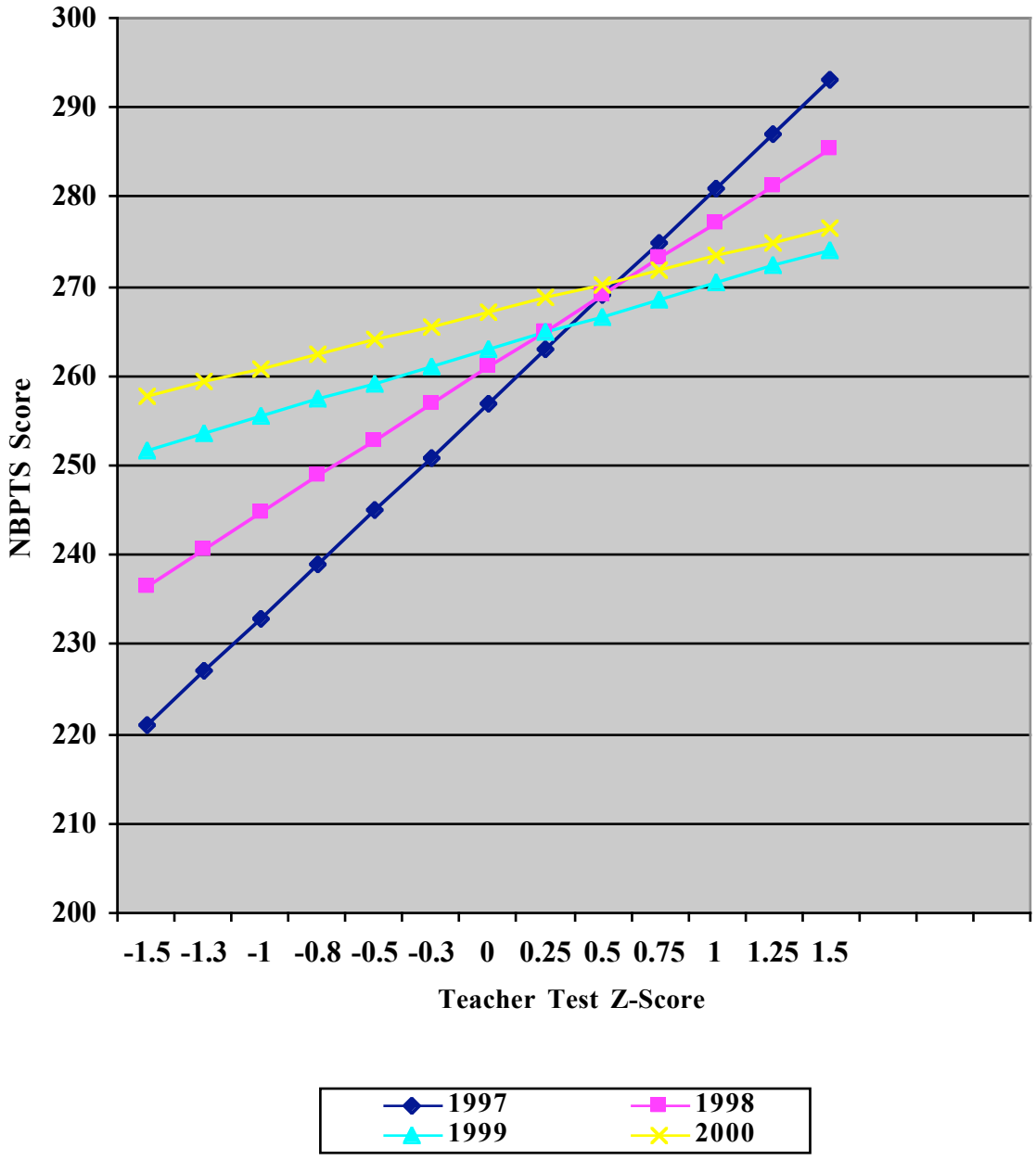
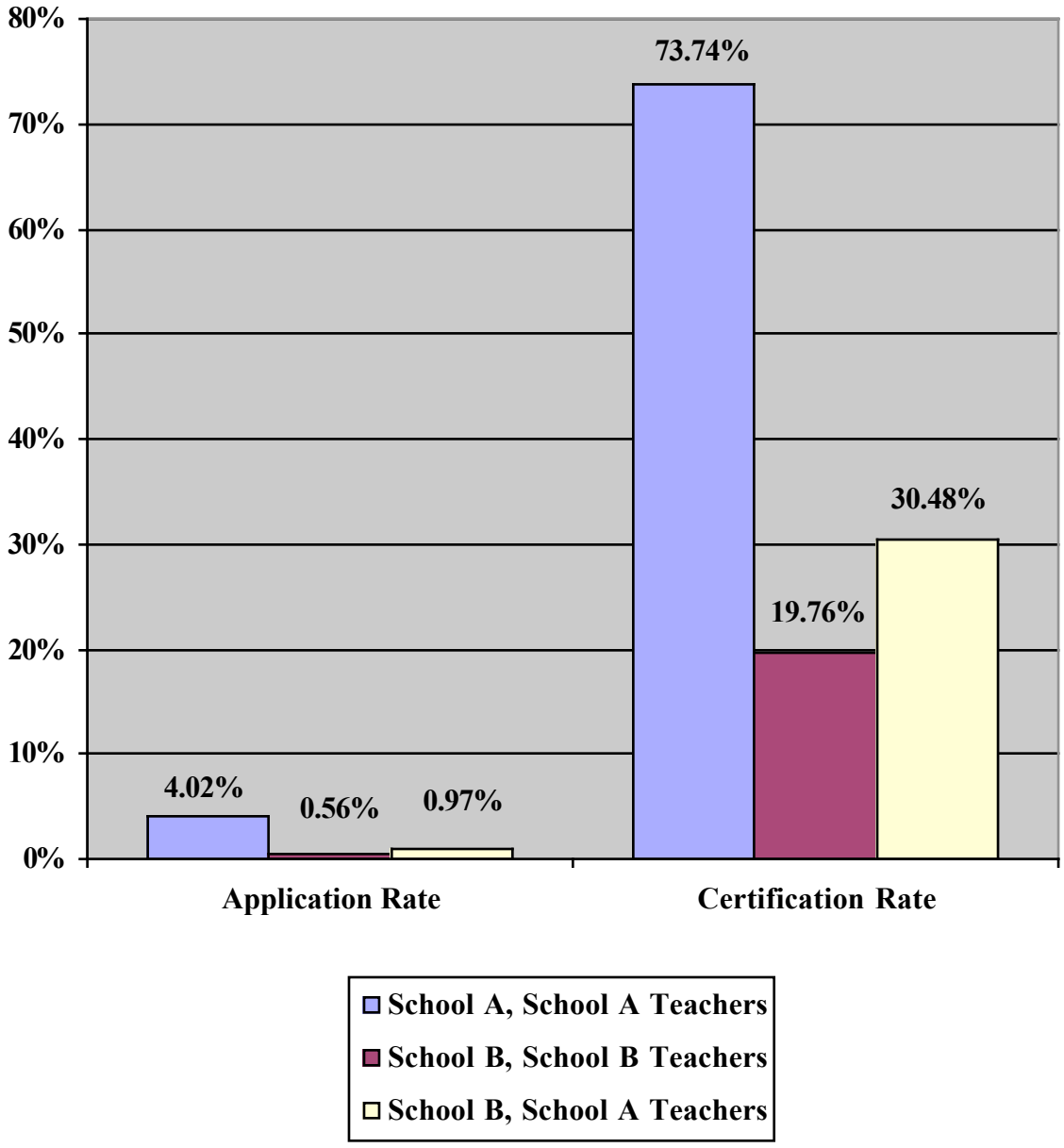
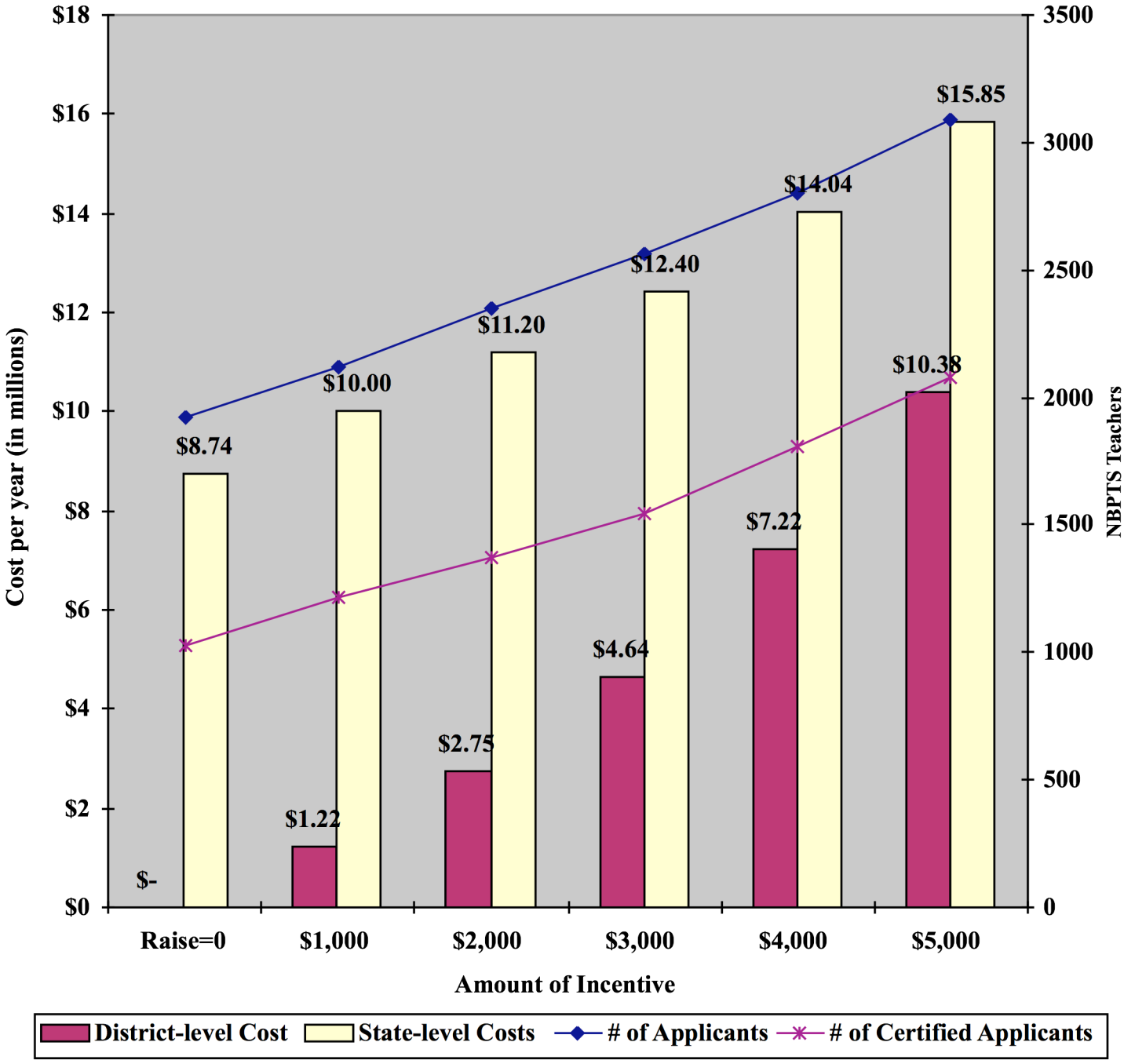


Figure 10. Estimated Application and Certification Rates: Advantaged (School A) vs. Disadvantaged (School B) High School[b]



[b] These application and certification rate predictions are based on two actual districts in the state chosen for their differing student demographic and performance characteristics.

Figure 11. Marginal Effects of Local Incentives on Applicants and Costs



Appendix A - Variable Definitions

TEACHER VARIABLES	DATA SOURCE	VARIABLE DEFINITIONS
Age	NCDPI	Age in years at start of each school year
Race/Ethnicity (Black), (Hispanic), (Asian)	NCDPI	Self-reported race/ethnicity of each teacher
Gender (Male)	NCDPI	Self-reported gender of each teacher
Individual 10 Month Salary	NCDPI	Individual teacher salary per month, over 10 month period
Years of Teaching Experience	NCDPI	Years of teaching experience that the state of North Carolina credits teachers with (can be for non-teaching but subject-related experience)
Teacher Z-Score	NCDPI	Average Z-score from Z-scores of various teacher tests on NC record such as Praxis I and II, NTE, and a small number of teacher observations that include GRE and/or SAT scores
Permanent License Status	NCDPI	Teacher is licensed on a permanent rather than temporary basis
North Carolina Based License	NCDPI	Teacher received license through an education program approved by, and located in, the state of North Carolina
Endorsed License	NCDPI	Teacher's license is classified as "endorsed" by N.C. standards, meaning that teacher can only teach a limited percentage of time/subjects during the day
Vocational License	NCDPI	Teacher's license permits them only to teach classes classified as "vocational."
Master's Degree	NCDPI	Dummy variable: Teacher's highest degree is Master's
Ph.D. /Other Advanced Degree	NCDPI	Dummy variable: Teachers highest degree is Ph.D. or other advanced degree
Prior Application to NBPTS	NBPTS	Dummy variable: Whether teacher had applied to NBPTS in previous year
1998	NCDPI	Dummy variable: Year =1998
1999	NCDPI	Dummy variable: Year =1999
2000	NCDPI	Dummy variable: Year =2000
1998*Teacher Z-Score	NBPTS	Interaction variable: Teacher Z-score and year 1998
1999*Teacher Z-Score	NBPTS	Interaction variable: Teacher Z-score and year 1999
2000*Teacher Z-Score	NBPTS	Interaction variable: Teacher Z-score and year 2000
NBPTS Assessment Score (Final)	NBPTS	Composite exam score for National Board applicants

*Note: For NBPTS variables, data is only available for teachers who applied for National Board Certification

SCHOOL VARIABLES	DATA SOURCE	VARIABLE DEFINITION
Students Performing At or Above Grade-Level	NDCPI	Percent of students performing at or above grade-level according to NCDPI-determined test score targets
Students Exceeding Expected Performance	NDCPI	Met exemplary growth of student performance (expected + 10%) according to NCDPI-determined test score targets
Other Current Applicants	NBPTS	NBPTS 'Peer Effect' Variable: Number of other teachers applying to NBPTS that year
Other Previous NBPTS-certified Applicants	NBPTS	NBPTS 'Peer Effect' Variable: Number of teachers who were NBPRTS certified in a previous year
Other Previous Unsuccessful NBPTS Applicants	NBPTS	NBPTS 'Peer Effect' Variable: Number of teachers who applied but were unsuccessful at achieving NBPTS certification in a previous year
Total PK_12 Students	Common Core of Data	Total number of students enrolled in grades PK-12
Minority Students	Common Core of Data	The percentage of minority students relative to the total student membership count
Student/Teacher Ratio	Common Core of Data	Total students divided by total number of full-time equivalent teachers
Free Lunch Students	Common Core of Data	This field contains the percentage of students eligible for free lunch programs under the National School Lunch Act. This does not include those eligible only for reduced-price lunch
DISTRICT VARIABLES	**DATA SOURCE**	**VARIABLE DEFINITION**
Other Current Applicants	NBPTS	NBPTS 'Peer Effect' Variable: Number of other teachers applying to NBPTS that year
Other Previous NBPTS Certified Applicants	NBPTS	NBPTS 'Peer Effect' Variable: Number of teachers who were NBPRTS certified in a previous year
Other Previous Unsuccessful NBPTS Applicants	NBPTS	NBPTS 'Peer Effect' Variable: Number of teachers who applied but were unsuccessful at achieving NBPTS certification in a previous year
NBPTS Incentives (Bonus)	Individual calls to North Carolina school districts	Amount of NBPTS Bonus Incentive
NBPTS Incentives (Salary Increment/Raise)	Individual calls to North Carolina school districts	Amount of NBPTS Salary Incentive (Raise)
Total Students	Common Core of Data	Total number of students enrolled in PK-12 grade in district's schools
Current Per Pupil Expenditures ($)	Common Core of Data	Current Expenditures are expenditures for the day-to-day operation of schools and school districts. They include expenditures for Instruction, Support Services, Food Services, and Enterprise Operations. They exclude expenditures for capital outlays and programs outside the regular pre-school to grade 12 scope.
Urbanicity (Urban, Suburban, Rural)	Common Core of Data	This is a composite of local codes from the schools. Urban districts are those in large or mid-size central cities. Suburban districts are found in the urban fringe of large or mid-size central cities. Rural districts are defined as those in large

		towns, small towns, or Census-defined rural areas.
% Education Expenditure Spent on Instruction	Common Core of Data	Instruction Expenditures Divided by Total Expenditures
Starting Salary with Bachelor's Degree and no experience	NCDPI web site and phone calls to individual school district offices	Starting salary for teachers with no experience and a BA in that district

COMMUNITY VARIABLES	DATA SOURCE	VARIABLE DEFINITION
Median Housing Value ($)	1990 Census Data	Median Value of all housing units in district. Value is the respondent's estimate of how much the property (house and lot, mobile home and lot, or condominium unit) would sell for if it were for sale.
% Children in Poverty	Common Core of Data	Percent of children in community living below poverty level
% Minority Children	Common Core of Data	Average percent non-white children in schools in that district
% Bachelor's or Higher Degree	Common Core of Data	Percent of residents with a Bachelor's degree or higher degree in community

Appendix B - Teacher Test Correlations

	Teacher Z-score	Praxis I Z-score	Praxis II Z-score	Combined Praxis Z-score
Teacher Z-score	1	.95	.91	.96
Praxis I Z-score	.95	1	.69	.96
Praxis II Z-score	.91	.69	1	.96
Combined Praxis Z-score	.96	.96	.92	1
N	251567	82239	215021	220360