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The Effects of NBPTS-Certified Teachers on Student Achievement

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Abstract

In this study we consider the efficacy of a relatively new and widely accepted certification system for teachers established by the National Board for Professional Teaching Standards (NBPTS). To address the limitations in past research on the subject, we utilize a unique database covering the universe of teachers and students in Florida for a four-year span to determine the relationship between NBPTS certification and the impact of teachers on student test scores from both low-stakes and high-stakes exams. Contrary to some previous studies, we find evidence that NBPTS certification provides a positive signal of a teacher's contribution to student achievement only in a few isolated cases. Our results do reinforce evidence from previous research that the process of becoming NBPTS certified does not increase teacher productivity. While there is some evidence that NBPTS-certified teachers who are paid to act as mentors enhance the productivity of their colleagues, the effectiveness of non-NBPTS certified teachers does not increase with increases in the total number of NBPTS-certified teachers in the same school.

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I. Introduction

There is growing evidence that teacher quality plays a central role in determining student achievement (Rivkin, Hanushek and Kain (2005), Rockoff (2004)), yet measuring teacher quality and rewarding superior teachers has proved difficult. Most states' teacher certification statutes require prospective public school teachers to pass paper-and-pencil tests of subject matter and teaching skills in order to teach.[1] In addition, many states mandate that public-school teachers have a degree from a university-based college of education that includes specific coursework and/or a minimum grade point average. However, there is little empirical evidence that these state regulations effectively distinguish between high and low-quality teachers (eg. Hanushek (1986, 1997), Harris and Sass (2006a), Jepsen (2005)). There is also growing interest in measuring the quality of existing teachers in order to develop merit pay systems that would link teacher compensation to teacher performance.[2]

One alternative to state-imposed teacher certification and merit pay initiatives is a voluntary system of teacher certification established by the National Board for Professional Teaching Standards (NBPTS) and adopted throughout the United States. The NBPTS has created a form of certification that is substantially more involved than state certification systems. There are three main components to the process: initial screening, preparation of a portfolio and successful completion of a set of assessment exercises. To be eligible to submit an application, teachers must have a bachelor's degree from an accredited institution of higher education, hold a state teaching license and have taught for three years prior to submitting their applications for NBPTS certification. Teachers meeting these requirements must then submit a portfolio that includes video-taped instruction in actual classroom settings, samples of student work, as well as a written commentary by the teacher regarding their own teaching practices. In addition, teachers must submit documentation regarding interactions with students' families, colleagues,

[1] State regulations governing the standards individuals must meet in order to teach in public schools are typically referred to as "teacher certification" requirements. This is rather different than the nomenclature in economics where entry requirements fall under the rubric of "licensure" and "certification" determines the right to use a particular professional title, but does not generally restrict who may practice.

[2] At least one statewide merit pay plan has been tried (Tennessee) and another is being implemented (Florida). More common are district-level merit pay systems (e.g., Dallas, Denver, Houston). While most of these systems are too new to evaluate their efficacy, Dee and Keys (2004) provide an analysis of the impact of Tennessee's system on student achievement.

and other educational actors and take part in computer-administered tests that focus on content knowledge.[3] The combination of portfolio preparation and assessment involves a substantial amount of time outside the classroom; most candidates spend 200-400 hours on preparing the portfolio alone. Many states subsidize the application process and grant monetary awards to teachers that become NBPTS-certified. Unlike merit pay programs, however, NBPTS participation is voluntary and renewals are only required once every ten years.[4]

The present study examines several questions regarding NBPTS certification and teacher quality. First, are teachers who become NBPTS-certified teachers (NBCTs) generally more effective than other teachers? That is, does NBPTS certification provide a valid signal of a teacher's contribution to student achievement? Second, do the effects of NBPTS-certified teachers vary by student sub-group, including by race, eligibility for free or reduced price lunches and initial achievement level? Third, given the extensive process that teachers go through to become certified, is there evidence that the process itself influences teacher effectiveness and increases their human capital? Fourth, do NBCTs affect the performance of their fellow teachers? In other words, are there spillovers that arise from mentoring or other interactions of NBCTs with their colleagues? Finally, even if NBPTS certification does provide a signal of teacher effectiveness, does it provide information above and beyond other commonly available information, such as state certification requirements and educational attainment?

To address these questions we employ a unique panel dataset covering the universe of public school teachers and students in Florida over a four-year span. We are able to link students and teachers to specific classrooms and are able to track the performance of students on standardized exams over time. Thus we are able to associate student learning gains with the specific teacher who is responsible for instruction in the academic area that is tested while controlling for other factors that affect student achievement, including unmeasured student characteristics and peer influences. We focus on teachers in math and reading/language arts,

[3] The particulars of the NBPTS assessment process have changed somewhat over time. Currently applicants must complete four portfolio entries and six essays at an assessment center. Applicants who began the process prior to 2002 had to complete six portfolio entries and four assessment center exercises. There was also a change in the relative weights assigned to video tapes and commentary on student work in 2002.

[4] It is also increasingly common for merit pay plans to be based on student test score gains. NBPTS, in contrast, is focused on demonstrated teacher knowledge and the qualities of observed teacher practice.

the two subjects tested in each of grades 3-10 in Florida.

Our work is similar in many respects to that of Goldhaber and Anthony (forthcoming), but builds on their work in important ways. First, because they possess at most three observations for each student and academic subject, they base most of there conclusions on the efficacy of NBPTS certification from models that use only observable characteristics to control for student heterogeneity.[5] In other work (Harris and Sass (2006b)) we demonstrate that failure to account for unobserved student heterogeneity can significantly alter, and probably biases, estimates of teacher quality. We therefore estimate models of student achievement gains that include student-specific fixed effects over three years. Second, our data from Florida include information about teachers in middle and high school, rather than just elementary school. Third, our sample of teachers and students at each grade level is much larger, allowing us to account for cohort effects and therefore to separate the effect of NBPTS certification from inter-temporal changes in the characteristics of teachers receiving the certification. The larger sample also allows for more precise estimates of NBPTS effects by student sub-group. Fourth, Florida has a system of bonuses for NBCTs who agree to act as mentors. Thus we are able to determine if non-NBCTs receive positive spillovers from their NBPTS-certified colleagues who are actively engaged in mentoring.

In the next section, we provide more detail on NBPTS certification, followed by a literature review in section III that summarizes existing empirical evidence. In sections IV and V we explain our methodology and describe the Florida data. Our findings are presented in section VI. A final section discusses the implications of our findings for policy.

II. History and Description of NBPTS

NBPTS arose from a report by the Carnegie Task Force on Teaching as a Profession (1986) that called for the formation of a non-profit private organization to create a new form of teacher certification separate from state certification systems. More than just identifying the

[5] Goldhaber and Anthony do estimate a model with student fixed effects. However, they do not draw conclusions from their fixed effects estimates since there are relatively few students with multiple observations in their panel who are taught by NBPTS certified teachers. We discuss their findings in more detail below.

most effective teachers, NBPTS was part of a larger move to establish a set of professional norms, standards and career stages and to "professionalize" teaching (Koppich et al. (2006)).

Since the organization's establishment in 1987, more than 47,000 teachers have earned NBPTS certification and an additional 20,000 have applied for one of the 24 different certificates, covering 14 different subject areas.[6] One reason for such extensive participation in NBPTS among teachers is that all 50 states and at least 544 school districts have adopted policies that provide incentives that both reduce the cost to teachers of seeking certification and provide long-term financial rewards for becoming certified. In most locations, state or local education agencies pay some or all of the $2,300 application fee charged by NBPTS and provide a permanent increase in salary for those who successfully complete the certification process. The fees from applicants, plus government grants, have been estimated to generate $600 million for NBPTS (Goldhaber and Anthony, forthcoming). In addition, the NBPTS-related salary enhancements have reached nearly $1 billion annually (Podgursky (2001)).

As of 2004, the state of Florida had more than 6,300 NBPTS-certified teachers, the second largest number of any U.S. state and 15 percent of the national total. As in other states, this is partially a result of a state law adopted in 1998 that subsidizes applications and rewards NBPTS certification recipients.[7] The state pays 90 percent of the NBPTS application fee and provides $150 for portfolio preparation. For those who achieve certification, Florida offers a salary bonus equal to 10 percent of the prior year's average statewide teacher's salary. NBPTS certified teachers in Florida receive an additional 10 percent bonus if they agree to provide the equivalent of 12 workdays of mentoring services to public school teachers within the state who do not hold NBPTS certification.[8] Some school districts within Florida provide additional incentives, such as extra stipends and allowing time spent on NBPTS certification to count toward professional development requirements.

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[6] Unless otherwise noted, the evidence in this section comes from the NBPTS web site, www.nbpts.org.

[7] See Florida Statutes § 1012.72 (2004) and http://www.firn.edu/doe/etp/legislation.html. Originally named the Excellent Teaching Program Act, the program was renamed as the Dale Hickam Excellent Teaching Program in 2002. For descriptions of the incentives provided in some other states see Goldhaber, Perry and Anthony (2004) and Humphrey, Koppich and Hough (2005).

[8] The teachers must also have passed their school district's annual performance appraisal to receive these bonuses.

III. Literature Review

A handful of recent studies provide empirical evidence on the impact of NBPTS-certified teachers on student achievement. Most relevant to the present study is the analysis of Goldhaber and Anthony (forthcoming), which examines the relationship between NBPTS certification status and a teacher's contribution to student achievement in North Carolina for three years, 1996/97 through 1998/99. Goldhaber and Anthony analyze 600,000 student-year observations and 32,000 teacher-year observations in grades 3, 4 and 5. A total of 416 unique current and future NBCTs are included in the analysis, 230 of which are certified by the last year of their analysis, 1998/99. They use these data to test both the signaling and human capital hypotheses associated with NBPTS certification.

Goldhaber and Anthony find that for both reading and math, the contribution of future NBPTS-certified teachers to student achievement ("value-added") exceeds that of the average teacher who does not eventually become NBPTS certified. This suggests that, before they go through the certification process, teachers who later apply for and obtain NBPTS certification are better than the average teacher who is never certified.[9] The size of the differential suggests that having a teacher who later becomes NBPTS certified boosts student achievement gains by up to 0.10 standard deviations per year for the average student. This finding is based on a model that relies on student covariates (race/ethnicity, gender, participation in free or reduced-price lunch (FRL), limited English proficiency and disability status) to control for student heterogeneity. The results are robust, however, when estimating models with student fixed effects, as well as when adding other measures of teacher quality that could be used as alternatives to NBPTS certification. These results suggest that NBPTS certification provides a valid signal of teacher effectiveness.

In addition to finding that future NBCTs (prior to applying for certification) are more effective than the average never-NBPTS-certified teacher, Goldhaber and Anthony find that future NBCTs are disproportionately effective with minority and FRL students. The largest

[9] Depending on the specification, the comparison group in Goldhaber and Anthony varies between non-applicants and never-NBPTS certified teachers (which includes some unsuccessful applicants). In our discussion of their paper, we focus on their specifications where they compare successful applicants with those teachers who never apply.

difference between the two types of teachers increases to 0.16 standard deviations for FRL students in mathematics.[10]

While teachers who eventually achieve NBPTS certification start out being more effective than their peers who do not become NBPTS certified, they become less effective during the application process. Goldhaber and Anthony estimate that the effectiveness of teachers during the application year is actually lower than teachers who do not become certified and the differential is equal or greater in magnitude to the advantage they initially held prior to certification. Goldhaber and Anthony posit that the 200 or more hours involved in preparing application materials may take away from class preparation time and thus have a negative effect on student achievement during the application process.

The effectiveness of NBCTs after they actually achieve certification is much less clear. Employing models that account for student heterogeneity with student covariates, Goldhaber and Anthony find that the value-added of teachers in their first year of certification is above the average of teachers who do not apply for NBPTS certification and somewhat higher than the average of future NBCTs. However, after the first year of certification, NBCTs are no more effective than their peers who never apply for NBPTS certification. When student fixed effects are used to capture both observed and unobserved time-invariant student heterogeneity, both first-year and post-first-year NBCTs are no more effective in reading than are teachers who never obtain NBPTS certification. For math, newly-NBPTS-certified teachers are estimated to be more effective than the average non-applicant teacher, but after the first year of certification they appear to be *less* effective than the average non-applicant teacher.

The fragility of Goldhaber and Anthony's post-certification estimation of NBCT's effectiveness highlights a more general concern about their methodology. Most of the models they estimate exclude student (or school) fixed effects and thus may not adequately control for unobserved characteristics of students and schools. Even when they do include fixed effects,

[10] Limiting the samples in this way could change the comparison group of teachers. Rather than the average non-NBPTS teacher, the comparison group is now the average non-NBPTS teacher who is assigned to at least one disadvantaged student. If these students are disproportionately assigned to lower quality teachers, then the difference estimated by Goldhaber and Anthony may reflect more the change in comparison group than any difference in the effectiveness of NBPTS teachers. However, the only teachers who would be excluded would be those who do not teach a single student in the respective category. Therefore, the influence of this on the results is likely to be small.

only one set of effects (students or schools) is included at a time. If NBCTs are not randomly assigned to schools and students are not randomly assigned to NBCTs within a school then omission of school and/or student fixed effects will yield biased estimates of the effectiveness of NBCTs. Any measured differences in the performance of NBCTs and non-NBCTs will reflect differences in the unobserved characteristics of the schools they work in and the students they teach, not just any true differences in teacher effectiveness.

There is ample evidence that NBCTs are in fact not randomly distributed among schools and students. Goldhaber and Anthony (2004) and Humphrey, Koppich and Hough (2005) find that NBPTS teachers are less likely to be working in schools with high percentages of poor, minority and low-performing students.[11] This is not surprising given the relatively high turnover of teachers in schools serving disadvantaged students and the tendency of teachers to migrate to schools serving more affluent populations.[12] In addition, Vandervoot, Amrein-Beardsley and Berliner (2004) find that few principals deliberately assign NBPTS teachers to disadvantaged students within schools. As discussed below, we also find evidence that the schools in which NBCTs work and the students that NBCTs teach in Florida are atypical. To account for these potential sources of selection bias, we focus on estimating models that include both student and school fixed effects and perform an extensive sensitivity analysis with other specifications.

The ability of Goldhaber and Anthony to determine the post-NBPTS-certification effectiveness of teachers is also hampered by possible changes in the cohorts of NBCTs over time. Their time period of analysis is 1996/97-1998/99, just when NBPTS certification began to gain widespread popularity. In their North Carolina data they observe only 75 teachers in their second year of NBPTS certification and all but 12 of these teachers are from a single cohort

[11] Humphrey, Koppich and Hough analyzed a cohort of the 18,806 teachers who earned NBPTS certification since 1998 in six states: California, Florida, Mississippi, North Carolina, Ohio, and South Carolina. (According to the NBPTS web site, www.nbpts.org, these six states represent more than 58 percent of all NBCTs nationwide since 1998.) The results showed that 19 percent of the NBPTS teachers were in schools ranked in the bottom 30 percent according to the respective state assessment systems. In addition, only 12 percent of NBPTS teachers work in high-poverty schools with more than 75 percent students eligible for FRL and 16 percent of the total teach in high-minority schools that more than 75 percent of their students are minority. Compared with the state average for all teachers, those with NBPTS certification are underrepresented in these schools, except California. The authors hypothesize that different patterns in distribution of NBPTS in California might be attributable to the large financial incentives for NBPTS teachers to work in low-performing schools.

[12] See Hanushek, Kain and Rivkin (1999).

(those certified in 1998), making it difficult to distinguish certification effects from cohort effects. If teachers who achieve NBPTS certification later are different in unmeasured ways than prior recipients then what appears to be changes in teacher effectiveness could in fact represent differences in the pre-certification effectiveness of teachers.

Cavalluzzo (2004) provides an analysis similar to Goldhaber and Anthony, although her study is limited to ninth and tenth grade students in a single large school district, Florida's Miami-Dade County. Her data include mathematics test scores for ninth graders in years 2000/01-2002/03 and for tenth graders in 2001/02-2002/03. She observes only 61 NBCTs and 101 applicants. In her model with student fixed effects she estimates the determinants of student achievement *levels* (rather than achievement gains) thereby ignoring the possible impact of prior school inputs on current achievement.[13] Her results are similar to those of Goldhaber and Anthony in that NBPTS teachers are more effective than other teachers in boosting student math achievement. However, they are different in several other ways: Cavalluzzo finds that the NBPTS effect is larger for students who are eligible for FRL, but not for minority students. Cavalluzzo's estimates of the effects of NBCTs on student achievement are generally smaller than those in Goldhaber and Anthony. Also, she finds there is no difference between teachers who applied and were rejected for NBPTS certification and those who became certified.

In addition to the analyses of NBPTS certification effects by Goldhaber and Anthony and by Cavalluzzo, there have been studies of NBPTS certification in Arizona (Vandevoort, Amrein-Beardsley and Berliner (2004)), South Carolina (Stephens (2003)) and Tennessee (Stone (2002)). However, each of these studies uses very small samples of NBCTs and employs less sophisticated analytical techniques. Consequently, the reliability of their findings is quite limited.[14]

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[13] Cavalluzzo also estimates achievement models that control for prior schooling inputs by including the lagged test score as an independent variable. Unfortunately, she uses ordinary least squares to estimate this formulation which produces biased estimates in achievement models with a lagged dependent variable on the right hand side (see Harris and Sass (2006b). In her full sample there are 108,000 student-year observations and 101 NBPTS applicants of which 61 obtain certification during her period of study. Estimation with student fixed effects requires multiple observations per student, which reduces her sample to 72,000 student-year observations and perhaps fewer than 61 NBPTS-certified teachers. Since each student must be observed at least twice and can be observed at most three times, the number of students in her fixed-effects sample is likely less than 30,000.

[14] Vandevoort, Amrein-Beardsley, and Berliner (2004) examine 35 NBPTS teachers using student gains on SAT-9 scores in reading, math, and language arts in grade levels 3-6. Stone (2002) analyzes 16 NBPTS teachers in 3rd through 8th grades using value-added scores from Tennessee's Value-Added Assessment System (TVASS).

IV. Methods

In order to gauge the impact of NBPTS certification we begin with a general specification of the "value-added" model that relates student achievement to vectors of time-varying student/family inputs (X), classroom-level inputs (C), school inputs (S) and time-invariant student/family characteristics (ψ):

$$A_{it} - A_{it-1} = \Delta A_{it} = \boldsymbol{\rho}_1 \mathbf{X}_{it} + \boldsymbol{\rho}_2 \mathbf{C}_{ijmt} + \boldsymbol{\rho}_3 \mathbf{S}_{mt} + \psi_i + \varepsilon_{it} \quad (1)$$

The subscripts denote individuals (i), classrooms (j), schools (m) and time (t).

Equation (1) is a restricted form of the cumulative achievement function specified by Todd and Wolpin (2003) where the achievement level at time t depends on the individual's initial endowment (eg. innate ability) and their entire history of individual, family and schooling inputs.[15] Although often not stated, there are a number of implicit assumptions underlying the value-added model function specified in (1). First, it is assumed that the cumulative achievement function does not vary with age, is additively separable and linear. Second, family inputs are constant over time and the impact of these parental inputs on achievement, along with the effect of the initial individual endowment on achievement, change at constant rates. This allows the combination of these time-invariant inputs to be represented by the student-specific fixed component, ψ_i. Third, the marginal impacts of all prior school inputs decline geometrically with the time between the application of the input and the measurement of achievement at the same rate. Thus lagged achievement serves as a sufficient statistic for all prior schooling inputs. Fourth, school inputs each have an immediate one-time impact on achievement that does not decay over time.[16] A thorough discussion of these assumptions and

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Stephens (2003) studies math achievement of 154 students in classrooms taught by NBPTS teachers in South Carolina using an ANOVA technique.

[15] It is important to note that while the dependent variable is the change in student achievement, equation (1) is a model of student achievement levels, not achievement growth. The lagged value of achievement on the left hand side serves to represent the cumulative effect of all prior schooling inputs on current achievement.

[16] Thus, for example, the quality of a child's kindergarten must have the same impact on their achievement at the end of age 5 as it does on their achievement at age 18. While a strong assumption, this allows the impact of all prior schooling inputs to be captured by the lagged achievement score, A_{it-1}, on the left-hand side of the equation. Otherwise, equation (1) would contain a lagged dependent variable on the right hand side and thus could not be

the derivation of the linear value-added model can be found in Todd and Wolpin (2003) and Harris and Sass (2006b).

The vector of classroom inputs can be divided into four components: peer characteristics, $\mathbf{P}_{-ijmt}$ (where the subscript –i students other than individual i in the classroom), time-varying teacher characteristics (eg. experience and certification), $\mathbf{T}_{kt}$ (where k indexes teachers), time-invariant teacher characteristics (eg. innate ability and pre-service education), δ_k. and non-teacher classroom-level inputs (such as books, computers, etc.), $\mathbf{Z}_j$. If we assume that, except for teacher quality, there is no variation in education inputs across classrooms within a school, the effect of $\mathbf{Z}_j$ becomes part of the school-level input vector, $\mathbf{S}_m$. If we further assume that school-level inputs are constant over the time span of analysis, they can be captured by a school fixed component, ϕ_m. Direct estimation of the school fixed effects, ϕ_m, while also controlling for student fixed effects is problematic since it requires inclusion of thousands of indicator variables, one for each school in the sample. In order to make the problem computationally tractable we combine the student and school fixed effects into a single effect, $\theta_{im} = \psi_i + \phi_m$, representing each unique student/school combination or "spell."[17] The value-added model can then be expressed as:

$$\Delta A_{it} = \boldsymbol{\beta}_1 \mathbf{X}_{it} + \boldsymbol{\beta}_2 \mathbf{P}_{-ijmt} + \boldsymbol{\beta}_3 \mathbf{T}_{kt} + \theta_{im} + \delta_k + \nu_{it} \qquad (2)$$

where ν_{it} is a normally distributed, mean zero error.

Teachers can be distinguished according to whether or not they ever receive NBPTS certification. Denote the average fixed effect for teachers who never become NBPTS certified as $\bar{\delta}^{\text{never NBCT}}$, which is simply a constant, α. We can then denote the difference in the average fixed effect for teachers who at some point become NBCTs and those who never become NBCTs $(\bar{\delta}^{\text{ever NBCT}} - \bar{\delta}^{\text{never NBCT}})$ as γ(Ever NBCT), where γ is a fixed parameter which is multiplied by

consistently estimated by ordinary least squares. In other work, Harris and Sass (2006b), we find that, except for extreme values, the degree of assumed persistence in the effect of prior schooling inputs has little effect on estimates of teacher effectiveness.

[17] For a more detailed discussion of the spell fixed-effects approach see Andrews, Schank and Upward (2004). Estimated standard errors for the spell-fixed-effects model are adjusted for clustering at the classroom level.

(Ever NBCT), a dummy variable representing teachers who become NBCTs at some point in time. The average fixed effect for teachers who become NBCTs at some point is thus $\alpha+\gamma$(Ever NBCT). Our value-added model can re-written as:

$$\Delta A_{it} = \alpha + \boldsymbol{\beta}_1 \mathbf{X}_{it} + \boldsymbol{\beta}_2 \mathbf{P}_{-ijmt} + \boldsymbol{\beta}_3 \mathbf{T}_{kt} + \gamma(\text{Ever NBCT}) + \theta_{im} + \nu_{it} \quad (3)$$

If the average effectiveness of current and future NBCTs exceeds the average of teachers who never become NBCTs then γ should be positive.

To be clear, in equation (3) we are comparing teachers who apply for and receive NBPTS certification with those who either never apply or who apply but fail to be certified. In other words, we measure the net impact of all of the NBPTS selection and screening effects. These include the NBPTS eligibility requirements which prohibit some teachers from applying, the self-selection of teachers to apply for certification (given the costs and benefits of applying) and the NBPTS evaluation system that determines whether or not an applicant achieves certification. The comparison of ever-NBCTs with teachers who do not become board certified is relevant for determining if the voluntary system currently in place rewards teachers who are more effective in boosting student achievement. Alternatively, one could compare unsuccessful applicants and successful applicants. This comparison would indicate if the certification process is successful in sorting out superior teachers within the group of applicants. This would be relevant if a state mandated that all teachers apply for NBPTS certification. However, we are unaware of any states that are considering making the NBPTS certification process mandatory.

The effectiveness of teachers who become NBPTS certified may change during the certification process. Following the work of Goldhaber and Anthony, it may be that teacher productivity temporarily falls during the certification process, but later recovers. In addition, it may be that the certification process itself enhances future teacher productivity. If the certification process leads teachers to re-evaluate their teaching methods or if preparation for the exam components causes teachers to sharpen their content knowledge then their effectiveness could rise after the certification process. To account for these possible inter-temporal changes

in the effectiveness of teachers who become NBPTS-certified, we interact the (Ever NBCT) variable with indicator variables denoting the three time periods: pre-application, application year and received certification. This yields:

$$\begin{aligned}\Delta A_{it} = {} & \alpha + \boldsymbol{\beta}_1 \mathbf{X}_{it} + \boldsymbol{\beta}_2 \mathbf{P}_{-ijmt} + \boldsymbol{\beta}_3 \mathbf{T}_{kt} + \gamma_1(\text{Ever NBCT} \times \text{Pre-Application}) + \\ & \gamma_2(\text{Ever NBCT} \times \text{Application Year}) + \gamma_3(\text{Ever NBCT} \times \text{Received Certification}) + \\ & \theta_{im} + \nu_{it}\end{aligned} \tag{4}$$

The coefficients γ_1, γ_2 and γ_3 represent the difference between the average effectiveness of teachers who are ever-NBPTS-certified and those who are never-NBPTS-certified during the relevant periods. Tests of whether these coefficients are statistically different from zero provide evidence regarding the signaling hypothesis. Evidence on the validity of the human capital hypothesis is provided by differences between the estimated Ever-NBCT interaction coefficients, ie. γ_2-γ_1 and γ_3-γ_1.

V. Data

A. Students, Teachers, and Related Non-Achievement Data

The primary source of our data is the Florida Department of Education's K-20 Education Data Warehouse (EDW), an integrated longitudinal database covering all Florida public school students and school employees from pre-school through college. Both the student and employee data can be linked to specific classrooms. Although student and teacher records are available since the 1995/1996 school year, curriculum-based statewide testing in consecutive grade levels did not begin in Florida until school-year 2000/2001. Thus our analysis is limited to the four-year period, 2000/2001–2003/2004.

Data on NBPTS certification have been matched to employee records in the EDW to identify which teachers are NBPTS certified and the timing of their certification. The data do not directly identify applicants, however. Therefore we are unable to distinguish between teachers who apply and fail and those who do not choose to apply.

As shown in Table 1, the NBPTS data cover all 6,355 certifications issued through calendar-year 2004. Thus for the last year of our achievement data, school-year 2003/2004, we are able to determine the teachers who become certified the following year. Table 1 also shows the number of teachers receiving each type of NBPTS certification in each year.[18] While the "generalist" certification is the most common, they do not represent a majority and there are hundreds of teachers in the Florida data who have certification in relevant subject-specific areas such as language arts, special education, science and math.

In addition to demographic and experience information, the EDW also includes detailed salary and benefits information for each teacher in Florida. Thus we can determine which NBCTs are being paid to mentor other, non-NBPTS-certified, teachers. This information allows us to determine if certification provides positive spillovers to other teachers.

Unlike previous studies, we are able to estimate the effects of NBCTs in elementary, middle and high school. Different types of challenges arise at each level. In elementary grades students usually have only one teacher and it is therefore relatively easy to assign student learning gains to specific teachers. The disadvantage of elementary school data is that it is more difficult to identify the influences of teachers and peers on student achievement because students generally have just a single teacher and peer group for the entire year. In middle and high school, the challenges are reversed: each student has many teachers, all of whom may affect measured student learning. But, it is easier to identify teacher and peer effects because the multiple classrooms provide variation in peer groups within a school year. In order to clearly determine which teacher is responsible for a student's academic achievement we limit our analysis to students who are enrolled in a single course in the relevant academic area. Also, we eliminate any students receiving instruction in classes where there is more than one primary teacher in the class.

We place two additional restrictions on the sample we analyze. First, to avoid atypical classroom settings we consider only courses in which 10-50 students are enrolled. Second, we eliminate students enrolled in charter schools from the analysis since they may have differing

[18] It is possible for teachers to earn more than one type of certification, although this is extremely rare in practice. This may in part be due to the fact that Florida's law only provides financial rewards for the first NBPTS; no additional rewards are provided for subsequent certifications.

curricular emphases and student-peer and student-teacher interactions may differ in fundamental ways from traditional public schools.

Despite these sample restrictions our data set is much larger than those used in previous analyses of NBPTS certification. For both math and reading we measure achievement for over one million students. As noted in Table 2, we observe nearly 30,000 math teachers, over 1,200 of which are NBPTS-certified at some point. We also observe over 32,000 reading/language arts teachers of which nearly 1,500 achieve NBPTS certification.[19] This is approximately three times the number of NBCTs analyzed by Goldhaber and Anthony and about 20 times the number included in Cavaluzzo's analysis.

Table 2 also describes the characteristics of teachers who are ever certified by NBPTS and of the students they teach, which is relevant to the issue of whether NBCTs are randomly assigned across different types of students. On average, teachers who at some point become NBPTS-certified are more experienced and are more likely to have earned an advanced degree than their peers who do not obtain NBPTS certification. Florida teachers who have or will become NBPTS-certified tend to have a smaller proportion of black students in their classes (16 percent) than teachers who never become certified (22 percent). They also have fewer FRL students—30 percent compared to 42 percent for never-NBPTS-certified teachers. It is not surprising, then, that students with prior test scores in the lowest national achievement quintile are also less likely to be taught by NBCTs.[20] Differences in the students being taught may partly reflect the characteristics of the teachers who become certified. Black students are more likely to be taught by black teachers in general and, as the table shows, black teachers in Florida are much less likely than Hispanic and non-Hispanic white teachers to receive NBPTS certification.

In our analyses with student fixed effects, the relative effectiveness of NBCTs is identified by changes in a student's achievement gains as they move between a teacher who is

[19] The number of NBCTs used in the analysis, and shown in Table 2, is much smaller than the total in Table 1 because most NBCTs teach in non-tested grades and subjects.

[20] The test score quintiles are based on national (rather than state) norms and therefore have unequal numbers of students. Specifically, there are substantially more students in the top quintile than the bottom, suggesting either that Florida students are above average on this test compared with the nation as a whole or the national norms are inflated.

never NBPTS certified and one who ever achieves NBPTS certification at some point. As noted in the last line of Table 2, a large proportion of students who are taught by an ever-NBCT are also taught in another period by a never-NBCT. As a result, there are over 50,000 students in the math sample and over 75,000 students in the reading sample that contribute to identification of the NBCT effects.

B. Student Achievement Data

During our period of analysis, the state administered two sets of reading and math tests to all third through tenth graders in Florida. The "Sunshine State Standards" Florida Comprehensive Achievement Test (FCAT-SSS) is a criterion-based exam designed to test a student's mastery of the state curriculum standards at each grade level. The second test is the Stanford-9 achievement test, known as the FCAT Norm-Referenced Test (FCAT-NRT) in Florida. For each exam we utilize scale scores that are normalized by grade and year for the period 2000/01-2003/04.[21]

We focus our analysis on changes in the normed scores from the FCAT-SSS, but also report findings based on FCAT-NRT normed scores when they differ from the FCAT-SSS results. Since the FCAT-SSS is aligned with the state curriculum benchmarks and is the basis for various forms of accountability, it should be more closely aligned with the curriculum taught in schools and therefore sensitive to changes in the quality of instruction. However, the link between the FCAT-SSS and accountability could lead some teachers to emphasize test-taking skills, a form of "teaching to the test." If Ever NBCTs and Never NBCTs are equally likely to engage in such behavior there will be no effect on the estimated differential in teaching effectiveness between Ever NBCTs and other teachers. However, if NBCTs are less prone to spend time on test taking skills then this would bias the measured effectiveness differential downward.

There may also be substantive differences in the content of the FCAT-SSS and FCAT-NRT exams. Discussions with officials of the Florida Department of Education indicate the

[21] The FCAT-SSS was first administered in all grades 3-10 in the 2000/01 school year whereas use of the FCAT-NRT in all grades 3-10 began one year earlier, in 1999/00. We utilize the 2000/01-2003/04 period to facilitate comparisons across the two exams. Extending the FCAT-NRT-based analysis to include the 1999/00 school year does not qualitatively change the results.

FCAT-SSS generally involves more challenging content standards and higher cognitive level questions compared with the FCAT-NRT. Also, in the FCAT-SSS math test, students are graded partly on the explanations they give with their answers, not just whether their final answer is correct. We discuss the potential importance of these differences in the context of the empirical findings.

VI. Results

In this section, we report estimates of equations (3) and (4). We report and focus on the coefficients related directly to NBPTS participation, though all models include time-varying student characteristics, time-varying peer characteristics, and time-varying teacher characteristics, especially teacher experience (see table notes for details). The inclusion of teacher experience is important because NBPTS teachers have more experience than the average teacher, as noted earlier. Because student tests were normalized based on the grade-by-year mean and standard deviation, coefficients can be interpreted as differences in teacher value-added, measured in standard deviation units.

A. Effects of NBPTS-Certified Teachers on Own Students' Performance

Table 3 shows the estimated impact of NBCTs on student achievement, holding constant student mobility, peer characteristics and time-invariant student and school characteristics. Results are shown for both the SSS and NRT exams. The first two columns of results contain estimates of equation (3), which includes only a single certification measure, whether the teacher is ever certified by NBPTS. This measure captures the average difference in "value added" by teachers who become NBPTS-certified by 2004 and those teachers who never obtain certification during the same period (controlling for experience and advanced degrees held by teachers). We find no significant differences in effectiveness between NBCTs and non-NBCTs in either subject or either student test.[22]

[22] In earlier versions of this paper, we found that NBCTs were more effective in teaching reading when the SSS exam was used. This result no longer holds when adjusting for clustering of errors at the classroom level.

To see if the certification process itself enhances teacher effectiveness we estimate equation (4), which splits the NBPTS certification indicator into three components: the time period prior to application year, the application year, and the period during which the teacher is NBPTS certified.[23] The estimates of equation (4) are reported in the second pair of columns, for math and reading, respectively. We find no difference between the effectiveness of NBCTs and non-NBCTs prior to or during the certification process in either math or reading. There is some evidence that NBCTs are more productive than never-NBPTS teachers after certification is completed in reading, based on the SSS exam scores. The SSS-exam-based reading results also indicate that teacher effectiveness drops during the application year. However, this is the only specification is which the pre-application and application-year NBCT coefficients are significantly different from one another. Table 3 also shows results for the effects of teacher experience, which are consistently positive and significant (relative to rookie teachers with no experience), and for graduate degrees, which are consistently insignificantly different from zero.

The divergence in results for the FCAT-SSS and FCAT-NRT exams in reading could be due to a number of factors, including differences in content and maximum levels of measured achievement or "ceiling effects." While a complete analysis of the sources of variation across the tests is beyond the scope of the present paper, we do provide some descriptive comparisons of scores on the two tests in Table 4. We find the correlation in achievement levels across the two exams is generally high, typically around 0.8. While the correlations vary across subjects, grades and years, no clear patterns emerge. In contrast to achievement levels, the correlation in individual student gains across the two tests tends to be rather low, around 0.2. The correlation in gain scores across exams appears to be even lower at the high school level. The low correlation of gain scores across the two exams is likely due in part to measurement error in each test that becomes compounded when examining changes in scores. It could also reflect differential test ceilings where gains on one exam are attenuated for high achieving students, creating a differential in measured student achievement gains across exams. This issue is partly addressed by including student fixed effects because students who start off at high levels of

[23] Like Goldhaber and Anthony, we assume that the application year is the one immediately preceding the year of certification and that the application process takes only one year. The Florida EDW does not include direct measures of the time periods of the certification process.

achievement, and who are therefore potentially affected by the ceiling, will simply have a lower average learning trajectory and therefore a smaller fixed effect. As an additional test, we re-estimated equations (3) and (4), dropping students who had scored in the 90th national percentile or greater on the previous year's NRT exam. The results were similar to those presented in Table 3.[24]

As noted in our discussion of the Goldhaber and Anthony paper, cohort and certification effects are potentially intertwined in the above specification. That is, each coefficient reflects differences between non-NBPTS teachers and different groups of NBPTS teachers. Since we only observe early recipients of NBPTS certification after they have been certified, they tend to disproportionably influence the estimated post-NBPTS-certification effects. Similarly, cohorts who become certified later have a relatively greater influence on the estimated pre-certification effectiveness of future NBCTs. In order to disentangle the cohort effects from the true certification effects, we separately estimate the achievement model for each of five cohorts of NBCTs. Results based on the SSS exam appear in Table 5 and estimates based on the NRT exam appear in Table 6.

The results in Table 5 suggest that early cohorts of teachers who became NBCTs are different from later cohorts and these cohort differences distort the estimated impacts of National Board certification. The 20 percent of teachers who received NBPTS certification in 2001 or before were more effective than other teachers, post-certification, in both math and reading. For the 2002 and 2003 cohorts of NBCTs, where data are available pre- and post-certification, we find ever-NBCTs are not significantly more effective than the average never-NBCT before seeking certification and their effectiveness does not significantly change during or after the certification process. This suggests that the initial cohorts of NBCTs were more effective to start with than were the later, post-2001 certification recipients. It is also possible that the NBPTS process improved productivity only for the early entrants, but this seems unlikely as the basic NBPTS certification process remained unchanged. Using the FCAT-NRT as the gauge of student performance (Table 6), the early entrants are no longer more effective than non-NBPTS

[24] In earlier versions of this work, we found more significant differences in results between the SSS and NRT. The significance of these differences diminished once we accounted for clustering of the errors at the classroom level.

teachers even post-certification, though the 2003 cohort is more effective in teaching math prior to certification than the average teacher who never becomes certified.

In an attempt to determine the source of the observed cohort differences, we calculate the mean observable characteristics of NBCTs by cohort for both math and reading. The resulting descriptive statistics are presented in Table 7. It appears that teachers in the earliest cohort of NBCTs were more likely to have advanced degrees, and had slightly more experience, compared with later cohorts of teachers. While we have controlled for experience and advanced degrees in our estimates, these changes seem consistent with the finding in Table 6 that teachers with higher initial quality were more likely to attempt and receive NBPTS certification in the early years of the state policy. In addition to the change in degree status, the initial entrants were more likely to be white females compared with later cohorts, though it is unclear what this might suggest about productivity. Given these differences in observables, it is quite possible that the earlier cohort differed from subsequent cohorts in their unobservable characteristics as well.

One possible reason that the estimated post-certification productivity appears negligible is that the certification process leads teachers to change their teaching practices and this leads to a temporary dip in performance as they master new ways of teaching. To explore this possibility of a delayed productivity effect, we re-estimate the achievement model by cohort, splitting the post-certification period into two components: the first year of certification (ie. the year certification is awarded) and all subsequent years. If the delayed-effect hypothesis is correct then teacher effectiveness should be relatively low the first year of certification and subsequently improve. Results are presented in Table 8 (for the SSS exam) and Table 9 (for the NRT exam). In only two instances, the 2002 SSS Math Cohort and the 2001 NRT Math Cohort, are the coefficients on NBCTs two or more years post certification greater than the coefficient corresponding to the first year of certification. In the remaining cases there is either no difference or the effectiveness of NBCTs actually falls with time after certification.

To further test for the possible human capital effects of the NBPTS certification process we also estimate models that include a fixed effect for each teacher that is ever NBPTS certified. This controls for any time invariant teacher characteristics and allows us to make a within-teacher comparison of effectiveness over time. The results, presented in Table 10, show no

indication that the NBPTS process boosts teachers' human capital. For both subjects and both exams none of the certification-year or post-certification coefficients are positive and statistically significant, indicating that the productivity of NBCTs is no greater during or after certification than prior to application. Similarly, F-tests fail to reject the null hypothesis that the during-certification and after-certification coefficients are equal.

Prior research suggests that the contribution of NBPTS certification varies by specific grade (Goldhaber and Anthony (forthcoming)) as do the contributions of teacher professional development (Harris and Sass (2006a)). Thus, depending on the attributes being measured by NBPTS, the value of NBPTS certification as a signal of teacher quality may vary by grade level as well.[25] To determine if this is the case, we separately estimate the student achievement model for elementary, middle and high-school students. The results, presented in Tables 11 and 12, are inconsistent across grade levels. In the elementary grades, NBCTs appear no different from other teachers in either subject, using either the SSS or NRT exam as a yardstick. In contrast, middle school math teachers are more productive pre-certification, but less effective post-certification using either exam. Using the SSS exam, middle school reading teachers who become NBCTs are more productive than never-NBCTs prior to certification, but the difference is no longer statistically significant post-certification. In high school, using the SSS exam, ever-NBCTs are no more effective than never-NBCTs pre-certification but more effective than never-NBCTs post-certification in math; there are no differences between ever-NBCTs and never-NBCTs either pre- or post-certification in reading using either exam.

The validity of NBPTS as a signal of productivity, or as a factor influencing productivity, may vary by student group. In Tables 13 and 14 we estimate the achievement model for students of different racial, ethnic, income and prior-achievement sub-groups. In the SSS-exam

[25] We also considered estimating separate effects for specific NBPTS certification fields (eg. math, language arts and "generalist"). However, there is little variation in certification fields within a subject area and grade level. At the elementary level in 2003/04, 98.1 percent of students receiving instruction from an NBCT are taught by an NBCT with a generalist certification. For middle-school reading, 91.1 percent of students taught by an NBCT are taught by an NBCT with a language arts certification. For high school reading the proportion is even higher at 93.8 percent. For high school math, 92.3 percent of the students receiving instruction by an NBCT are taught by an NBCT with a mathematics certification. The only area where there is modest variation is in middle school math where 61.1 percent of students taught by an NBCT are being instructed by an NBCT certified in math. NBCTs with a generalist certification instruct another 23.0 percent and 7.5 percent are taught by NBCTs with a science certification.

based analysis (Table 13), the only pre-certification coefficient that is statistically significant is for the impact of NBPTS-certified teachers on reading achievement of students receiving free or reduced price lunches. In the FCAT-NRT analysis (Table 14), the only significant coefficient is a negative pre-certification effect of NBCTs on the achievement of initially high achieving students in reading.

We noted earlier that NBCTs in Florida can become mentors and therefore have a formal responsibility to help other teachers. We might expect that teachers who choose to act as mentors are ones that are particularly confident in their teaching skills and are more effective than other NBCTs. Likewise, administrators may encourage the most effective NBCTs to engage in mentoring. But mentors, by definition, also have added responsibilities which, like the NBPTS application process, may take time away from their own students. Results of estimating achievement regressions that distinguish between mentor and non-mentor NBCTs are presented in Tables 15 (for the SSS) and 16 (for the NRT). For both exams and both subjects, nearly all of the mentor-related coefficients are statistically insignificant, suggesting that NBPTS mentors are no more or less effective than other teachers. The only significant coefficient in the two tables suggests that NBPTS teachers who are never mentors are less effective than non-NBPTS teachers while they go through the certification process.

B. Spillover Effects

Based on the absence of differences between NBCTs and other teachers when teaching their own students, it seems unlikely that NBCTs would have measurable effects on the productivity of non-NBCTs within their schools. Nonetheless, we test this possibility in a model that includes variables for the number of NBCTs in a given school. To separate the direct effect of NBCTs on their own students (identified in previous tables), the sample of students is limited to those who are taught by teachers who never become NBPTS certified. Thus the reference point is the average effectiveness of never-NBCTs within a school over time. Results based on the SSS and NRT exams are presented in Tables 17 and 18, respectively. Interestingly, whether using the SSS or NRT exam, the effectiveness of never-NBPTS-certified teachers in mathematics appears to decline with increases in the number of ever-NBPTS-certified

teachers in the same school, suggesting a negative rather than positive spillover. The effect is small, however, equivalent to 0.005 of a standard deviation in student achievement.[26] We find no significant spillovers for reading teachers.

Even though there do not appear to be positive spillovers from the average NBCT, it is still possible that increasing the number of NBCTs who are being paid to mentor may result in greater learning for students of non-NBPTS teachers. With the FCAT-SSS, we find that mentoring NBCTs have no effect on the productivity of never-NBCTs. However, estimates based on the FCAT-NRT suggest that students taught by non-NBCTs learn more in math and in reading when there are more mentoring NBCTs in the school. The magnitude of these apparent positive spillovers is small, however, about 1.5 percent of a standard deviation.[27]

C. Specification Checks

The results in the previous tables utilize a specification that includes student and school fixed effects to control for time-invariant student and teacher characteristics. The advantage of the fixed effects approach is that it controls for unobserved characteristics of teachers and schools that are time invariant, thereby mitigating selection bias due to non-random assignment of students and teachers to schools and to classrooms within a school. As noted above, however, the fixed effects approach only exploits information from students who are observed in both ever-NBCT and never-NBCT classrooms to identify the impact of ever-NBCTs on student achievement. A related potential problem from using student fixed effects is that the method alters the reference group. In the absence of student fixed effects, ever-NBCTs are compared to the average never-NBCT in the entire sample. In contrast, with student fixed effects, ever-

[26] While small, this is a surprising result and could possibly suggest that the inclusion of student and school fixed effects do not fully address the non-random assignment of teachers to schools. Our models include school fixed effects which control for any time-invariant differences in school quality. However, if the number of NBCTs at a school is correlated with unobserved time-varying changes in school quality then the estimated spillovers could partly reflect other school-level inputs that are changing over time. For example, a new principal might boost test scores and at the same time encourage (or possibly discourage) teachers from becoming NBCTs. However, it is expected that improvements in school quality would likely be positively correlated with increases in the number of NBCTs, which would tend to bias the estimates toward finding a positive impact of the number of NBCTs at a school on the effectiveness of non-NBCTs.

[27] The positive externality from mentoring NBCTs is rather surprising given that almost none of the previous FCAT-NRT results indicate that NBCTs, whether mentors or not, are more effective in teaching reading to their own students. This anomalous finding may simply reflect some sort of omitted variable bias.

NBCTs are compared to never-NBCTs who taught the same students. In the presence of student tracking by ability and non-random assignment of teachers and students, it is possible that never-NBCTs who teach students that also encounter ever-NBCTs are different in unmeasured ways from the average never-NBCT.[28]

To determine if altering the reference group is a significant problem, we re-estimated our math achievement model, dropping the NBCT variables and including fixed effects for all teachers (in addition to the student fixed effects). We then compared the average effectiveness of never-NBCTs who taught a student who also encountered an ever-NBCT with the average effectiveness of all never-NBCTs. The results indicate that for students who encounter both a never-NBCT and an ever-NBCT the average teacher effect for never-NBCTs is 0.002 larger than the average teacher effect of never-NBCTs in the full sample. While consistent with student tracking and non-random assignment, the differential is too small to have a meaningful impact on our results.

Tables 19 and 20 indicate how the estimates change if these controls are removed and/or student covariates are used in place of student fixed effects. For purposes of comparison, the estimates with both student and school fixed effects from Table 3 are reproduced in columns [1] and [6] of each table. For the SSS exam, the statistical significance of both the pre-certification and post-certification NBCT effects varies depending on whether and how student and school heterogeneity are taken into account. Omission of school or student fixed effects tends to boost the statistical significance of the NBCT estimates. However, even when the effectiveness differential between NBCTs and never-NBCTs is statistically significant, the estimated magnitude of the differential is small. The estimated impact on student achievement from having an NBCT versus the average never-NBCT is in the range of 0.01 to 0.02 standard deviations. Given that NBCTs are more likely to work in schools serving students from more affluent schools, the finding of some statistically significant differentials when student and school fixed effects are omitted is not surprising. Failing to control for unobserved heterogeneity in students or schools means the effects of these characteristics are captured by the teacher variables. Teachers who teach better-than-average students or who teacher in above-

[28] We are grateful to an anonymous referee for pointing this out.

average schools would falsely appear relatively productive due to omitted variable bias. A similar pattern is observed in the estimates based on the FCAT-NRT. The patterns are less clear with the application year effects, however, where nearly all of the coefficients are insignificant, regardless of specification.

It is also worth comparing our results to the main specifications in Goldhaber and Anthony, which omit student and school fixed effects (most closely approximated by columns [4] and [9] in our Tables 19 and 20). Using the FCAT-SSS, if we had estimated only these specifications, the NBPTS process would appear to be a valid signal of teacher quality in both math and reading, though once again the magnitudes are small, in the range of one to two percent of a standard deviation in student achievement. There would even be some support for a human capital effect in reading, with a p-value for the F-test of equality of the pre- and post-certification coefficients equal to 0.07.[29] The same conclusions arise with the NRT, as shown in Table 20, though the differences in signals appear only in the post-certification coefficients.

In the previous tables, we have compared NBPTS teachers to all teachers, including those who have little experience or otherwise would not be eligible to apply for NBPTS certification. While we control for experience in the above results, another approach is to drop the teachers from the sample who possess less than three years of experience or who are not fully certified and thus ineligible for NBPTS. The results of this alternative approach, shown in Tables 21 and 22, indicate that the method used to control for differences in experience does not matter. For both the FCAT-SSS exam and the FCAT-NRT exam, the results for the restricted sample of NBPTS-eligible teachers are essentially the same as for the full sample. This is true whether or not one controls for experience and advanced degrees in the NBPTS-eligible sample.[30]

VII. Conclusion

With its extensive process to gauge teacher practice and knowledge, combined with significant salary enhancements for those who meet the requirements, National Board

[29] It is important to keep in mind, however, that these results do not account for the cohort effects discussed above.
[30] Note that the change in sample does significantly change the estimates of the experience coefficients. This is due to the fact that the comparison group changes when omitting the least experienced teachers and the fact that experience effects are most important in the early years of teaching, as shown in the full-sample columns of Table 21.

certification represents a substantial departure from extant systems of evaluating and compensating teachers. Although there is great potential for improving student outcomes by identifying superior teachers and offering differential rewards, we find relatively little support for NBPTS certification as a signal of teacher effectiveness. In general we find that prior to certification, future NBCTs are no more effective in raising student test scores than are other teachers who are never observed to become NBCTs. Across our many alternative samples, specifications and measures of student achievement we occasionally find a positive signaling effect for a particular cohort of future NBCTs for a particular test or grade level, but these are the exception, not the rule. Even when positive signaling effects are found, the magnitudes are relatively small, on the order of one to two percent of a standard deviation in student achievement. The one instance where we find relatively consistent positive and substantial signaling effects is for future NBCTs who are middle school math teachers.

In addition to identifying superior teachers, advocates argue that the NBPTS certification process itself could improve teacher quality and that NBCTs might help enhance the effectiveness of their colleagues through formal or informal mentoring. We find no support for the notion that going through the process of NBPTS certification boosts teacher productivity, however. Holding teacher characteristics constant by following a given cohort of NBCTs over time or by estimating within-teacher performance over time we find no significant improvements in teacher performance during or after the certification process. Further, we find no consistent evidence that increases in the number of NBCTs at a school improve the effectiveness of non-NBCTs. However, based on one of the two achievement tests in Florida we do find evidence that NBCTs explicitly agree to mentor other teachers improve the effectiveness of their colleagues.

Our results differ in some ways from previous similar studies. One reason is that these Florida data allow us to control for unobserved differences in students and schools. The omission of these factors is important because teachers are not randomly assigned to students or schools and, thus, any apparent quality differences between NBCTs and other teachers may just reflect the clearly non-random process of teacher assignment rather than any real differences or improvements in productivity. Without student fixed effects to control for unobserved student

heterogeneity, the signaling effects as well as the estimated post-certification effectiveness of NBCTs become more precise, yet the magnitudes of the NBCT effects are still quite modest.

Unlike previous studies that could only compare different teachers at different stages of the NBPTS certification process, we are able to compare specific cohorts of teachers to themselves before and after they achieve certification. Interestingly, we find some evidence that early successful applicants in Florida are more effective than never-NBPTS teachers post-certification, but this is not the case for subsequent cohorts. It appears that the first teachers to become NBCTs were different in their measured characteristics, and perhaps in other, unobserved ways as well. It is not clear what factors lead to the apparent change over time in the type of teachers that applied and obtained National Board certification.

Unlike most studies using value-added analysis in education, our data include two distinct student tests, a "high-stakes" based on the state curriculum standards and a "low-stakes" test used to establish national rankings. The choice of tests has some influence on specific coefficients, but almost no influence on the general conclusions. No matter which test we consider, the results still suggest that NBPTS certification is a poor signal of teacher productivity and the process of certification does not improve productivity.

Based on our findings for Florida, the efficacy of NBPTS as a tool to improve student learning appears questionable. The two main potential benefits are to identify and reward productive teachers and to encourage teachers to improve their teaching skills. Our results suggest that NBPTS does neither, at least when teacher productivity is measured in terms of student achievement gains soon after a teacher becomes certified. It is possible that future research will find long-term benefits or improvements in other student outcomes. Even if that occurs, however, it is also important to consider the costs that go into the certification—teacher time, NBPTS administration and direct financial incentives—as well as other possible means of accomplishing the same objective of increased teacher effectiveness. Ultimately, the evaluation of NBPTS, with its distinctive mixture of certification, preparation and monetary rewards, will require comparing its costs and effects with those of other possible avenues to improving teacher quality and student outcomes.

References

Andrews, Martyn, Thorsten Schank and Richard Upward. 2004. "Practical Estimation Methods for Linked Employer-Employee Data." University of Nottingham. Unpublished.

Angrist, Joshua D. and Jonathan Guryan. 2004. "Teacher Testing, Teacher Education, and Teacher Characteristics." *American Economic Review* 94(2):241-246.

Carnegie Task Force on Teaching as a Profession. 1986. *A Nation Prepared: Teachers for the 21st Century*.

Cavalluzzo, Linda C. 2004. *Is National Board Certification An Effective Signal of Teacher Quality?* Alexandria, Virginia: The CNA Corporation.

Dee, Thomas S., and Benjamin J. Keys. 2004. "Does Merit Pay Reward Good Teachers? Evidence from a Randomized Experiment." *Journal of Policy Analysis and Management* 23(3):471-488.

Goldhaber, Dan, and Emily Anthony. (forthcoming). "Can Teacher Quality Be Effectively Assessed? National Board Certification as a Signal of Effective Teaching." *Review of Economics and Statistics*.

Goldhaber, Dan, David Perry, Emily Anthony. 2004. "The National Board for Professional Teaching Standards (NBPTS) Process: Who Applies and What Factors Are Associated with NBPTS Certification?," *Educational Evaluation and Policy Analysis* 26(4):259-280.

Hanushek, Eric A. 1986. "The Economics of Schooling: Production and Efficiency in Public Schools." *Journal of Economic Literature* 24(3):1141-1177.

Hanushek, Eric A. 1997. "Assessing the Effects of School Resources on Student Performance: An Update." *Educational Evaluation and Policy Analysis* 19(2):141-164.

Hanushek, Eric A., John F. Kain, and Steven G. Rivkin. 1999. "Do Higher Salaries Buy Better Teachers?" National Bureau of Economic Research Working Paper No. 7082.

Harris, Douglas, and Tim R. Sass. 2006a. "The Effects of Teacher Training on Teacher Value-Added." Florida State University. Unpublished.

Harris, Douglas, and Tim R. Sass. 2006b. "Value-Added Models and the Measurement of Teacher Quality." Florida State University. Unpublished.

Humphrey, Daniel C., Julia E. Koppich, and Heather J. Hough. 2005. "Sharing the Wealth: National Board Certified Teachers and the Schools that Need Them Most." *Education Policy Analysis Archives* 13(18).

Jepsen, Christopher. 2005. "Teacher Characteristics and Student Achievement: Evidence from Teacher Surveys." *Journal of Urban Economics* 57:302-319.

Koppich, Julia E., Daniel C. Humphrey, and Heather J. Hough. 2006. "Making Use of What Teachers Know and Can Do: Policy, Practice, and National Board Certification." Paper presented at the 2006 annual meeting of the American Education Research Association, San Francisco, CA.

McCaffrey, Daniel F., J. R. Lockwood, Daniel M. Koretz, and Laura S. Hamilton. 2003. *Evaluating Value-Models for Teacher Accountability*. Santa Monica, CA: RAND Corporation.

Podgursky, Michael 2001. "Defrocking the National Board: Board: Will the Imprimatur of 'Board Certification' Professionalize Teaching?" *Education Matters* 1(2):79-82.

Rivkin, Steven G., Eric A. Hanushek and John F. Kain. 2005. "Teachers, Schools and Academic Achievement." *Econometrica* 73(2):417-58.

Rockoff, Jonah E. 2004. "The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data." *American Economic Review* 94(2): 247-52.

Stephens, Angela D. 2003. "The Relationship between National Board Certification for Teachers and Student Achievement." Unpublished doctoral dissertation, University of South Carolina.

Stone, John E. 2002. "The Value-Added Achievement Gains of NBPTS-Certified Teachers in Tennessee: A Brief Report." East Tennessee State University. Unpublished.

Todd, Petra E. and Kenneth I. Wolpin. 2003. "On the Specification and Estimation of the Production Function for Cognitive Achievement." *Economic Journal* 113(485):F3-F33.

Vandevoort, Leslie G., Audrey Amrein-Beardsley, and David C. Berliner. 2004. "National Board Certified Teachers and Their Students' Achievement." *Education Policy Analysis Archives* 12(46).

Table 1
Number of New NBPTS Certifications in Florida by Field and Year

	Before 1999	1999	2000	2001	2002	2003	2004	All Years
All Fields	27	525	670	981	1,238	1,446	1,468	6,355
Art	9	25	21	38	47	55	42	237
Counseling	0	0	0	0	0	0	69	69
ESL	0	0	11	13	15	23	26	88
Foreign Languages	0	0	0	0	28	46	33	107
General	12	284	328	439	499	515	503	2,580
Language Arts	3	73	84	136	117	155	130	698
Library/Media	0	0	0	0	62	60	78	200
Literacy	0	0	0	0	0	0	46	46
Math	0	51	35	60	71	63	106	386
Music	0	0	0	0	50	54	51	155
Physical Education	0	0	0	21	23	47	23	114
Science	3	59	68	69	75	95	77	446
Social Studies/History	0	33	35	59	53	78	66	324
Special Education	0	0	61	116	151	199	162	689
Vocational/Technical	0	0	27	30	47	56	56	216

Table 2
Sample Characteristics
Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04

	Math Sample		Reading Sample	
	Never NBPTS Certified	Ever NBPTS Certified	Never NBPTS Certified	Ever NBPTS Certified
Number of Teachers	29,865	1,230	32,528	1,464
Proportion Male	0.221	0.076	0.150	0.060
Proportion Black	0.174	0.033	0.165	0.037
Proportion Hispanic	0.090	0.097	0.092	0.085
Proportion with Advanced Degree	0.302	0.494	0.301	0.506
Average Years of Experience	9.517	10.370	9.237	10.009
Ever NBPTS Certified in Math		0.256		
Ever NBPTS Certified in Language Arts				0.314
Ever NBPTS Mentor		0.177		0.183
Number of Students (Total)	862,355	69,761	987,860	96,985
Proportion Black	0.220	0.157	0.226	0.156
Proportion Hispanic	0.205	0.196	0.203	0.193
Proportion Free/Reduced Price Lunch	0.415	0.307	0.425	0.303
Average Achievement Gain on FCAT-SSS	0.006	0.022	-0.007	0.014
Average Achievement Gain on FCAT-NRT	-0.014	0.005	-0.018	-0.009
Proportion in Lowest Achievement Quintile	0.090	0.050	0.128	0.069
Proportion in Highest Achievement Quintile	0.348	0.486	0.247	0.360
Number of Students With Both Never-NBPTS-Certified and Ever-NBPTS-Certified Teachers	52,897	52,897	76,032	76,032

Note: Samples are restricted to students with at least two valid achievement gain scores on both the FCAT-SSS and FCAT-NRT exams during the period 2000/01-2003/04. Achievement quintiles are based on national percentile ranking of exam score in previous year. Time-varying teacher characteristics (advanced degrees and experience) and time-varying student characteristics (free-lunch status, achievement gain, achievement quintile) are averaged over time by student and then averaged over students. Student totals represent the number of students ever exposed to a never NBPTS-certified or a never-NBPTS-certified teacher and thus do not sum to the total number of students in the sample.

Table 3
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics
(Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math				Reading			
	SSS Exam	NRT Exam	SSS Exam	NRT Exam	SSS Exam	NRT Exam	SSS Exam	NRT Exam
Ever NBPTS Certified	0.0103 (1.31)	0.0038 (0.43)			0.0117 (1.55)	-0.0027 (0.34)		
Ever NBPTS Certified × Pre-Application Period			0.0119 (0.90)	0.0126 (0.84)			0.0223 (1.54)	-0.0038 (0.26)
Ever NBPTS Certified × Application Year			0.0048 (0.32)	-0.0057 (0.32)			-0.0191 (1.33)	-0.0111 (0.70)
Ever NBPTS Certified × Received Certification			0.0116 (1.04)	0.0024 (0.19)			0.0189* (1.95)	0.0011 (0.11)
1-2 Years of Experience	0.0356*** (4.31)	0.0356*** (4.13)	0.0355*** (4.30)	0.0355*** (4.12)	0.0247*** (3.20)	0.0147* (1.84)	0.0249*** (3.23)	0.0148* (1.85)
3-4 Years of Experience	0.0427*** (4.62)	0.0410*** (4.18)	0.0427*** (4.63)	0.0409*** (4.17)	0.0208** (2.39)	0.0134 (1.45)	0.0212** (2.44)	0.0135 (1.48)
5-9 Years of Experience	0.0469*** (5.50)	0.0466*** (5.09)	0.0469*** (5.50)	0.0466*** (5.09)	0.0223*** (2.73)	0.0153* (1.77)	0.0227*** (2.78)	0.0154* (1.79)
10-14 Years of Experience	0.0526*** (6.01)	0.0563*** (6.03)	0.0526*** (6.01)	0.0564*** (6.04)	0.0304*** (3.63)	0.0249*** (2.85)	0.0306*** (3.65)	0.0249*** (2.85)
15-24 Years of Experience	0.0448*** (5.29)	0.0538*** (5.98)	0.0448*** (5.29)	0.0538*** (5.98)	0.0329*** (4.09)	0.0249*** (2.97)	0.0331*** (4.12)	0.0250*** (2.98)
25 or More Years of Experience	0.0440*** (4.78)	0.0476*** (4.89)	0.0440*** (4.78)	0.0475*** (4.88)	0.0341*** (3.84)	0.0349*** (3.58)	0.0342*** (3.85)	0.0330*** (3.58)
Advanced Degree	0.0041 (1.06)	0.0058 (1.39)	0.0041 (1.05)	0.0058 (1.39)	-0.0101** (2.54)	-0.0002 (0.06)	-0.0102* (1.91)	-0.0003 (0.08)

F-Test P-Values of NBCT Effects:								
App. Year = Pre-App.			0.71	0.42			0.03	0.73
Received Cert. = Pre-App.			0.98	0.60			0.84	0.78
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.645	0.620	0.645	0.620	0.665	0.641	0.665	0.641
No. of Student-Year Obs.	1,449,310	1,449,310	1,449,310	1,449,310	1,707,256	1,707,256	1,707,256	1,707,256

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixed effects, grade-by-year indicators and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 4
Correlation of Normed FCAT-SSS and FCAT-NRT Normed Score Levels and Normed Score Gains by Grade and Year
(Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math				Reading			
	2000/01	2001/02	2002/03	2003/04	2000/01	2001/02	2002/03	2003/04
				Levels				
Grade 3	0.7730	0.7541	0.7583	0.7424	0.7515	0.7400	0.7584	0.7345
Grade 4	0.8137	0.8085	0.7934	0.6975	0.7861	0.8113	0.8055	0.6921
Grade 5	0.8123	0.8346	0.8187	0.8159	0.8274	0.8324	0.8310	0.8248
Grade 6	0.8313	0.8306	0.8150	0.8341	0.8172	0.8260	0.8155	0.7882
Grade 7	0.8461	0.8336	0.8337	0.8391	0.8071	0.8053	0.8027	0.7884
Grade 8	0.8204	0.8290	0.8362	0.8381	0.7789	0.7977	0.8009	0.7803
Grade 9	0.8345	0.8203	0.8197	0.8180	0.8083	0.8011	0.7963	0.7935
Grade 10	0.6644	0.7924	0.7789	0.7807	0.7349	0.7716	0.7557	0.7565
				Gains				
Grade 3								
Grade 4		0.2529	0.2485	0.4026		0.2531	0.2547	0.4127
Grade 5		0.2390	0.2190	0.2050		0.1778	0.1994	0.1807
Grade 6		0.2064	0.1995	0.2077		0.2247	0.2101	0.2004
Grade 7		0.2102	0.1938	0.1953		0.1835	0.1792	0.1707
Grade 8		0.2054	0.1730	0.1560		0.1488	0.1452	0.1251
Grade 9		0.1864	0.1745	0.1462		0.1623	0.1620	0.1451
Grade 10		0.1412	0.1150	0.0970		0.1391	0.0998	0.1121

Table 5
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, By NBPTS Certification Cohort Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004
Ever NBPTS Certified × Pre-Application Period			0.0313	0.0457	0.0004			0.0389	0.0088	0.0384*
			(0.50)	(1.58)	(0.02)			(0.59)	(0.35)	(1.91)
Ever NBPTS Certified × Application Year		0.0594	-0.0349	0.0268	0.0006		-0.0422	-0.0317	-0.0095	-0.0294
		(1.09)	(1.09)	(1.06)	(0.02)		(0.70)	(1.11)	(0.46)	(0.73)
Ever NBPTS Certified × Received Certification	0.0376**	-0.0150	-0.0138	-0.0026		0.0411**	-0.0025	0.0324	-0.0245	
	(2.13)	(0.67)	(0.62)	(0.06)		(2.33)	(0.15)	(1.56)	(0.83)	
No. of Teachers in Cohort	275	210	242	234	281	316	272	279	308	316
F-Test P-Values:										
App. Year = Pre-App.			0.33	0.62	0.99			0.32	0.56	0.12
Received Cert. = Pre-App.			0.49	0.35				0.92	0.38	
R-squared	0.656	0.652	0.657	0.657	0.656	0.680	0.681	0.681	0.679	0.681
No. of Student-Year Obs.	1,394,591	1,387,986	1,390,996	1,389,963	1,396,134	1,626,557	1,624,518	1,623,875	1,630,802	1,625,228

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixed effects, grade-by-year indicators and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 6
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, By NBPTS Certification Cohort Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004
Ever NBPTS Certified × Pre-Application Period			-0.0048	0.0867***	-0.0137			0.0012	0.0228	-0.0102
			(0.07)	(2.64)	(0.77)			(0.02)	(0.87)	(0.52)
Ever NBPTS Certified × Application Year		0.0180	-0.0478	0.0381	-0.0201		-0.0265	-0.0382	0.0021	-0.0060
		(0.26)	(1.36)	(1.31)	(0.61)		(0.38)	(1.27)	(0.08)	(0.14)
Ever NBPTS Certified × Received Certification	0.0067	-0.0197	0.0204	0.0236		-0.0024	-0.0170	0.0151	0.0236	
	(0.34)	(0.77)	(0.78)	(0.49)		(0.14)	(0.85)	(0.61)	(0.84)	
No. of Teachers in Cohort	275	210	242	234	281	316	272	279	308	316
F-Test P-Values:										
App. Year = Pre-App.			0.54	0.25	0.86			0.56	0.55	0.93
Received Cert. = Pre-App.			0.72	0.28				0.83	0.98	
R-squared	0.633	0.636	0.635	0.635	0.633	0.659	0.659	0.659	0.658	0.659
No. of Student-Year Obs.	1,394,591	1,387,986	1,390,996	1,389,963	1,396,134	1,626,557	1,624,518	1,623,875	1,630,802	1,625,228

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixed effects, grade-by-year indicators and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 7
Characteristics of NBPTS-Certified Teachers By Year of NBPTS Certification
(Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004
Prop. Male	0.055	0.081	0.068	0.097	0.084	0.038	0.053	0.059	0.071	0.078
Prop. Black	0.004	0.057	0.034	0.030	0.044	0.022	0.056	0.037	0.032	0.039
Prop. Hispanic	0.066	0.124	0.093	0.105	0.102	0.073	0.102	0.089	0.081	0.085
Prop. With Adv. Degree	0.613	0.529	0.481	0.451	0.400	0.631	0.519	0.482	0.481	0.415
Avg. Yrs. Exp. At Cert.	11.835	10.822	10.437	10.564	10.917	11.742	10.958	10.105	10.733	10.123
Ever NBPTS Cert. in Math	0.247	0.231	0.244	0.218	0.325					
Ever NBPTS Cert. in LA						0.296	0.326	0.285	0.364	0.296

Table 8
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, By NBPTS Certification Cohort Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004
Ever NBPTS Certified × Pre-Application Period			0.0308	0.0457	0.0004			0.0389	0.0088	0.0384*
			(0.50)	(1.58)	(0.02)			(0.59)	(0.35)	(1.91)
Ever NBPTS Certified × Application Year		0.0578	-0.0373	0.0268	0.0006		-0.0394	-0.0319	-0.0095	-0.0294
		(1.06)	(1.16)	(1.06)	(0.02)		(0.66)	(1.12)	(0.46)	(0.73)
Ever NBPTS Certified × First Year of Certification	0.1590**	-0.0245	-0.0379	-0.0026		0.0679	0.0138	0.0300	-0.0245	
	(2.09)	(0.63)	(1.39)	(0.06)		(0.74)	(0.47)	(1.17)	(0.83)	
Ever NBPTS Certified × After First Year of Certification	0.0331*	-0.0098	0.0346			0.0401**	-0.0114	0.0368		
	(1.86)	(0.38)	(1.00)			(2.24)	(0.53)	(1.14)		
No. of Teachers in Cohort	275	210	242	234	281	316	272	279	308	316
F-Test P-Values:										
App. Year = Pre-App.			0.31	0.62	0.99			0.32	0.56	0.12
First-Year Cert. = Pre-App.			0.31	0.35				0.90	0.38	
Afer First-Yr. Cert. = Pre-App.			0.96					0.98		
First-Yr. = After First Yr. Cert	0.10	0.74	0.09			0.77	0.48	0.86		
R-squared	0.656	0.658	0.657	0.657	0.656	0.6804	0.681	0.681	0.679	0.681
No. of Student-Year Obs.	1,394,591	1,387,986	1,390,996	1,389,963	1,396,134	1,626,557	1,624,518	1,622,875	1,630,802	1,625,228

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixed effects, grade-by-year indicators and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 9
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, By NBPTS Certification Cohort Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004	Certified Prior to 2001	Certified in 2001	Certified in 2002	Certified in 2003	Certified in 2004
Ever NBPTS Certified × Pre-Application Period			-0.0053	0.0867***	-0.0137			0.0014	0.0228	-0.0102
			(0.08)	(2.64)	(0.77)			(0.02)	(0.87)	(0.52)
Ever NBPTS Certified × Application Year		0.0093	-0.0507	0.0381	-0.0201		-0.0292	-0.0366	0.0021	-0.0060
		(0.13)	(1.44)	(1.31)	(0.61)		(0.42)	(1.22)	(0.08)	(0.14)
Ever NBPTS Certified × First Year of Certification	0.0005	-0.0734*	-0.0081	0.0236		0.0123	-0.0329	0.0443	0.0236	
	(0.01)	(1.85)	(0.27)	(0.49)		(0.14)	(0.98)	(1.45)	(0.84)	
Ever NBPTS Certified × After First Year of Certification	0.0069	0.0096	0.0778*			-0.0029	-0.0084	-0.0443		
	(0.35)	(0.30)	(1.71)			(0.16)	(0.36)	(1.08)		
No. of Teachers in Cohort	275	210	242	234	281	316	272	279	308	316
F-Test P-Values:										
App. Year = Pre-App.			0.52	0.25	0.86			0.57	0.55	0.93
First-Year Cert. = Pre-App.			0.97	0.28				0.53	0.98	
After First-Yr Cert. = Pre-App.			0.29	0.01				0.56	0.38	
First-Yr = After First Yr. Cert.	0.94	0.09	0.11			0.87	0.53	0.07		
R-squared	0.633	0.636	0.634	0.6346	0.633	0.659	0.659	0.659	0.658	0.659
No. of Student-Year Obs.	1,394,591	1,387,986	1,390,996	1,289,963	1,396,134	1,626,557	1,624,518	1,623,875	1,630,802	1,625,228

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixed effects, grade-by-year indicators and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 10
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics Plus Individual-Specific Time-Invariant Characteristics of NBPTS-Certified Teachers (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math		Reading	
	SSS Exam	NRT Exam	SSS Exam	NRT Exam
Ever NBPTS Certified × Application Year	-0.0032 (0.15)	0.0038 (0.14)	-0.0490** (1.98)	-0.0125 (0.46)
Ever NBPTS Certified × Received Certification	-0.0223 (0.71)	0.0009 (0.02)	-0.0468 (1.44)	0.0089 (0.25)
F-Test P-Values: Received Cert. Year = Pre-App.	0.43	0.92	0.93	0.42
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes
Ever-NBPTS-Cert. Teacher Fixed Effects	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.648	0.622	0.667	0.643
No. of Student-Year Obs.	1,449,310	1,449,310	1,707,256	1,707,256

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 11
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, By Grade Level Using FCAT-SSS Data (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math			Reading		
	Elementary (Grades 4-5)	Middle (Grades 6-8)	High (Grades 9-10)	Elementary (Grades 4-5)	Middle (Grades 6-8)	High (Grades 9-10)
Ever NBPTS Certified × Pre-Application Period	-0.0388 (1.34)	0.0648** (2.45)	0.0211 (1.07)	0.0293 (0.90)	0.0508** (2.17)	-0.0018 (0.09)
Ever NBPTS Certified × Application Year	-0.0004 (0.01)	-0.0157 (0.51)	0.0268 (1.11)	-0.0134 (0.39)	0.0004 (0.02)	-0.0520** (2.34)
Ever NBPTS-Certified × Received Certification	0.0284 (1.31)	-0.0470* (1.82)	0.0343** (2.13)	0.0317 (1.52)	0.0212 (1.51)	0.0065 (0.38)
F-Test P-Values:						
App. Year = Pre-App.	0.37	0.04	0.85	0.34	0.10	0.09
Received Cert. Year = Pre-App.	0.06	0.00	0.60	0.95	0.27	0.75
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.661	0.653	0.688	0.7056	0.672	0.6115
No. of Student-Year Obs.	495,181	453,187	500,942	637,421	615,741	454,094

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 12
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, By Grade Level Using FCAT-NRT Data (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math			Reading		
	Elementary (Grades 4-5)	Middle (Grades 6-8)	High (Grades 9-10)	Elementary (Grades 4-5)	Middle (Grades 6-8)	High (Grades 9-10)
Ever NBPTS Certified × Pre-Application Period	-0.0147 (0.48)	0.0731*** (2.56)	0.0036 (0.14)	-0.0183 (-0.61)	-0.0018 (-0.01)	0.0071 (0.34)
Ever NBPTS Certified × Application Year	-0.0155 (0.45)	0.0030 (0.09)	0.0035 (0.11)	0.0001 (0.00)	0.0051 (0.20)	-0.0382 (1.53)
Ever NBPTS-Certified × Received Certification	0.0142 (0.62)	-0.0519** (2.00)	0.0042 (0.20)	-0.0202 (0.50)	0.0204 (1.24)	-0.0115 (0.60)
F-Test P-Values:						
App. Year = Pre-App.	0.99	0.11	1.00	0.69	0.87	0.14
Received Cert. Year = Pre-App.	0.45	0.00	0.99	0.82	0.50	0.50
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.638	0.641	0.669	0.684	0.644	0.602
No. of Student-Year Obs.	495,181	453,187	500,942	637,421	615,741	454,094

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 13
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, by Student Demographics Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Black Students	Hispanic Students	Students Receiving Free Lunch	Students w/ 1-20 NPR In Prior Year	Students w/ 81-99 NPR in Prior Year	Black Students	Hispanic Students	Students Receiving Free Lunch	Students w/ 1-20 NPR in Prior Year	Students w/ 81-99 NPR in Prior Year
Ever NBPTS Certified × Pre-Application Period	0.0305	-0.0344	0.0043	-0.0809	0.0107	0.0588	0.0182	0.0595*	0.1172	0.0372
	(0.90)	(1.19)	(0.14)	(0.35)	(0.53)	(1.60)	(0.64)	(1.92)	(0.67)	(1.05)
Ever NBPTS Certified × Application Year	0.0106	0.0129	-0.0014	-0.0395	0.0021	0.0037	0.0087	0.0196	-0.0715	-0.0050
	(0.30)	(0.39)	(0.04)	(0.12)	(0.10)	(0.11)	(0.31)	(0.64)	(0.40)	(0.15)
Ever NBPTS-Certified × Received Certification	-0.0026	0.0069	-0.0049	0.0791	0.0244	0.0364	0.0134	0.0243	-0.0055	0.0179
	(0.09)	(0.30)	(0.20)	(0.40)	(1.51)	(1.41)	(0.66)	(1.14)	(0.04)	(0.81)
F-Test P-Values:										
App. Year = Pre-App.	0.67	0.26	0.90	0.91	0.77	0.25	0.80	0.34	0.43	0.35
Received Cert. Year = Pre-App.	0.44	0.25	0.81	0.60	0.59	0.61	0.89	0.33	0.57	0.64
R-squared	0.688	0.645	0.710	0.820	0.663	0.709	0.680	0.743	0.827	0.706
No. of Student-Year Obs.	301,262	303,916	578,035	110,711	540,694	358,375	347,701	688,911	181,274	462,782

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixded effects, grade-by-year dummies and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 14
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement Controlling for Individual, Peer and School Characteristics, by Student Demographics Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	Black Students	Hispanic Students	Students Receiving Free Lunch	Students w/ 1-20 NPR In Prior Year	Students w/ 81-99 NPR in Prior Year	Black Students	Hispanic Students	Students Receiving Free Lunch	Students w/ 1-20 NPR in Prior Year	Students w/ 81-99 NPR in Prior Year
Ever NBPTS Certified × Pre-Application Period	0.0409	-0.0273	0.0013	-0.0102	-0.0123	0.0182	-0.0116	-0.004	-0.0257	-0.0738**
	(1.26)	(0.85)	(0.04)	(0.10)	(0.72)	(0.51)	(0.37)	(0.02)	(0.29)	(2.21)
Ever NBPTS Certified × Application Year	-0.0225	-0.0272	-0.0363	0.0716	0.0044	0.0206	0.0035	0.0111	-0.0220	-0.0315
	(0.61)	(0.74)	(1.00)	(0.56)	(0.15)	(0.57)	(0.10)	(0.33)	(0.23)	(0.97)
Ever NBPTS-Certified × Received Certification	-0.0112	0.0020	-0.0027	-0.0314	0.0051	0.0083	0.0012	0.0039	0.0478	-0.0085
	(0.41)	(0.08)	(0.11)	(0.30)	(0.25)	(0.32)	(0.06)	(0.18)	(0.69)	(0.39)
F-Test P-Values:										
App. Year = Pre-App.	0.18	1.00	0.41	0.61	0.54	0.96	0.74	0.79	0.98	0.34
Received Cert. Year = Pre-App.	0.21	0.46	0.92	0.88	0.46	0.82	0.73	0.90	0.51	0.09
R-squared	0.669	0.618	0.700	0.902	0.691	0.691	0.647	0.731	0.903	0.753
No. of Student-Year Obs.	301,262	303,916	578,035	110,711	540,694	358,375	347,701	688,911	181,274	462,782

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include student/school fixded effects, grade-by-year dummies and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 15
Estimates of the Effects of NBPTS-Certified Teachers who Mentor on Student Achievement Controlling for Individual, Peer and School Characteristics Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math		Reading	
	[1]	[2]	[3]	[4]
Ever NBPTS Certified × Pre-Application Period × Never Mentor	0.0131 (0.88)	0.0086 (0.51)	0.0266 (1.56)	0.0028 (0.16)
Ever NBPTS Certified × Application Year × Never Mentor	0.0165 (0.90)	0.0092 (0.43)	-0.0317* (1.74)	-0.0066 (0.32)
Ever NBPTS Certified × Received Certification × Never Mentor	-0.0138 (0.87)	-0.0230 (1.34)	0.0182 (1.24)	-0.0004 (0.03)
Ever NBPTS Certified × Pre-Application Period × Ever Mentor	-0.1625 (1.42)	0.0695 (0.49)	-0.0670 (1.03)	-0.0866 (1.38)
Ever NBPTS Certified × Application Year × Ever Mentor	-0.0186 (0.36)	-0.1133 (1.62)	-0.0325 (0.67)	-0.0582 (1.29)
Ever NBPTS Certified × Received Certification × Ever Mentor	0.0430 (1.26)	0.0316 (0.77)	-0.0031 (0.08)	0.0281 (0.62)
Ever Mentor × Mentoring in Current Year		0.0002 (0.00)		-0.0109 (0.22)
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.649	0.624	0.670	0.647
No. of Student-Year Obs.	1,432,035	1,432,035	1,677,756	1,677,756

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 16
Estimates of the Effects of NBPTS-Certified Teachers who Mentor on Student Achievement Controlling for Individual, Peer and School Characteristics Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math		Reading	
	[1]	[2]	[3]	[4]
Ever NBPTS Certified × Pre-Application Period × Never Mentor	0.0121 (0.79)	0.0086 (0.51)	0.0031 (0.20)	0.0028 (0.16)
Ever NBPTS Certified × Application Year × Never Mentor	0.0021 (0.12)	0.0092 (0.43)	-0.0046 (0.27)	-0.0066 (0.32)
Ever NBPTS Certified × Received Certification × Never Mentor	-0.0061 (0.41)	-0.0230 (1.34)	-0.0033 (0.27)	-0.0004 (0.03)
Ever NBPTS Certified × Pre-Application Period × Ever Mentor	0.0478 (0.69)	0.0695 (0.49)	-0.0827 (1.39)	-0.0866 (1.38)
Ever NBPTS Certified × Application Year × Ever Mentor	-0.0812 (1.23)	-0.1133 (1.62)	-0.0595 (1.46)	-0.0582 (1.29)
Ever NBPTS Certified × Received Certification × Ever Mentor	0.0260 (1.14)	0.0316 (0.77)	0.0104 (0.52)	0.0281 (0.62)
Ever Mentor × Mentoring in Current Year		0.0002 (0.00)		-0.0109 (0.22)
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.620	0.624	0.642	0.647
No. of Student-Year Obs.	1,447,816	1,432,035	1,703,655	1,677,756

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 17
Estimates of the Impact of the Numbers of NBPTS-Certified Teachers and NBPTS-Certified Teachers Acting as Mentors in a School on the Effectiveness of Never-NBPTS-Certified Teachers Controlling for Individual, Peer and School Characteristics Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math		Reading	
	[1]	[2]	[3]	[4]
Number of Ever-NBPTS-Certified Teachers in School	-0.0050* (1.75)		-0.0004 (0.12)	
Number of Ever-NBPTS-Certified Teachers in School who are Mentoring		0.0058 (1.16)		-0.0040 (0.68)
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.719	0.724	0.740	0.743
No. of Student-Year Obs.	1,133,710	1,119,873	1,329,997	1,313,137

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 18
Estimates of the Impact of the Numbers of NBPTS-Certified Teachers and NBPTS-Certified Teachers Acting as Mentors in a School on the Effectiveness of Never-NBPTS-Certified Teachers Controlling for Individual, Peer and School Characteristics Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math		Reading	
	[1]	[2]	[3]	[4]
Number of Ever-NBPTS-Certified Teachers in School	-0.0058* (1.95)		-0.0006 (0.18)	
Number of Ever-NBPTS-Certified Teachers in School who are Mentoring		0.0146** (2.43)		0.0137** (2.28)
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes
R-squared	0.696	0.700	0.721	0.725
No. of Student-Year Obs.	1,133,710	1,119,873	1,329,997	1,313,137

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying teacher characteristics are a set of experience category dummies and an indicator for teachers possessing an advanced degree. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 19
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement With/Without Controls for Individual and School Characteristics Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Ever NBPTS Certified × Pre-Application Period	0.0119 (0.90)	0.0054 (0.60)	0.0060 (1.11)	0.0123** (2.32)	0.0114** (2.13)	0.0223 (1.54)	0.0184** (2.17)	0.0123*** (2.68)	0.0129** (2.88)	0.0105** (2.33)
Ever NBPTS Certified × Application Year	0.0048 (0.32)	0.0063 (0.60)	0.0043 (0.71)	0.0096 (1.62)	0.0082 (1.37)	-0.0191 (1.33)	-0.0088 (0.97)	0.0031 (0.61)	0.0065 (1.27)	0.0047 (0.91)
Ever NBPTS Certified × Received Certification	0.0116 (1.04)	0.0157** (2.19)	0.0166*** (3.97)	0.0172*** (4.16)	0.0162*** (3.90)	0.0190* (1.95)	0.0216*** (3.65)	0.0200*** (5.83)	0.0226*** (6.98)	0.0204*** (6.27)
F-Test P-Values:										
App. Year = Pre-App.	0.71	0.95	0.83	0.72	0.69	0.03	0.03	0.16	0.92	0.39
Received Cert. Year = Pre-App.	0.98	0.37	0.11	0.46	0.47	0.84	0.76	0.17	0.07	0.07
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Time-Invariant Char.	No	No	Yes	Yes	No	No	No	Yes	Yes	No
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	No	No	No	Yes	Yes	No	No	No
School Fixed Effects	Yes	No	Yes	No	No	Yes	No	Yes	No	No
R-squared	0.645	0.495	0.048	0.032	0.028	0.665	0.465	0.028	0.022	0.018
No. of Student-Year Obs.	1,449,310	1,449,310	1,449,310	1,449,310	1,449,310	1,707,256	1,707,256	1,707,256	1,707,256	1,707,256

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Time-invariant student characterisitcs are: female, black, hispanic, free/reduced-price lunch, limited English proficiency, disability status. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 20
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement With/Without Controls for Individual and School Characteristics Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math					Reading				
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]
Ever NBPTS Certified × Pre-Application Period	0.0126	0.0093	0.0079	0.0153***	0.0074	-0.0038	-0.0009	0.0010	0.0034	0.0155
	(0.84)	(0.90)	(1.37)	(2.66)	(1.29)	(0.26)	(0.11)	(0.22)	(0.76)	(0.35)
Ever NBPTS Certified × Application Year	-0.0057	0.0092	0.0037	0.0101	0.0037	-0.0111	-0.0019	0.0028	0.0076	0.0041
	(0.32)	(0.75)	(0.56)	(1.54)	(0.56)	(0.70)	(0.19)	(0.54)	(1.44)	(0.79)
Ever NBPTS Certified × Received Certification	0.0024	0.0097	0.0141***	0.0189***	0.0148***	0.0011	0.0060	0.0064*	0.0077**	0.0079**
	(0.19)	(1.17)	(3.05)	(4.16)	(3.21)	(0.11)	(0.96)	(1.84)	(2.31)	(2.30)
F-Test P-Values:										
App. Year = Pre-App.	0.42	0.99	0.79	0.54	0.65	0.73	0.94	0.78	0.55	0.70
Received Cert. Year = Pre-App.	0.60	0.98	0.15	0.62	0.31	0.78	0.51	0.33	0.55	0.25
Teacher Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Time-Invariant Char.	No	No	Yes	Yes	No	No	No	Yes	Yes	No
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	No	No	No	Yes	Yes	No	No	No
School Fixed Effects	Yes	No	Yes	No	No	Yes	No	Yes	No	No
R-squared	0.620	0.454	0.045	0.028	0.041	0.641	0.435	0.026	0.020	0.028
No. of Student-Year Obs.	1,449,310	1,449,310	1,449,310	1,449,310	1,449,310	1,707,256	1,707,256	1,707,256	1,707,256	1,707,256

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Time-invariant student characterisitcs are: female, black, hispanic, free/reduced-price lunch, limited English proficiency, disability status. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size. Teacher experience categories and advanced degree indicator are also included.

Table 21
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement: Full Sample versus NBPTS-Eligible Teachers, With and Without Controls for Experience and Advanced Degrees Using FCAT-SSS Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math			Reading		
	Full Sample	NBPTS Eligible Teachers	NBPTS Eligible Teachers	Full Sample	NBPTS Eligible Teachers	NBPTS Eligible Teachers
Ever NBPTS Certified × Pre-Application Period	0.0119 (0.90)	0.0155 (0.84)	0.0150 (0.81)	0.0223 (1.54)	0.0164 (0.81)	0.0133 (0.65)
Ever NBPTS Certified × Application Year	0.0048 (0.32)	0.0134 (0.69)	0.0133 (0.69)	-0.0191 (1.33)	-0.0265 (1.29)	-0.0297 (1.46)
Ever NBPTS Certified × Received Certification	0.0116 (1.04)	0.0183 (1.24)	0.0187 (1.27)	0.0190* (1.95)	0.0095 (0.71)	0.0076 (0.58)
1-2 Years of Experience	0.0355*** (4.30)			0.0249*** (3.23)		
3-4 Years of Experience	0.0273*** (4.63)			0.0212** (2.44)		
5-9 Years of Experience	0.0469*** (5.50)	0.0012 (0.13)		0.0227*** (2.78)	0.0025 (0.28)	
10-14 Years of Experience	0.0526*** (6.01)	0.0084 (0.90)		0.0306*** (3.65)	0.0147 (1.54)	
15-24 Years of Experience	0.0448*** (5.29)	0.0024 (0.27)		0.0331*** (4.12)	0.0132 (1.47)	
25 or More Years of Experience	0.0440*** (4.78)	0.0051 (0.51)		0.0342*** (3.85)	0.0193* (1.90)	
Advanced Degree	0.0041 (1.05)	0.0004 (0.08)		-0.0102** (2.55)	-0.0086 (1.46)	
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.645	0.725	0.725	0.665	0.740	0.740
No. of Student-Year Obs.	1,449,310	1,030,793	1,030,794	1,707,256	1,186,310	1,186,311

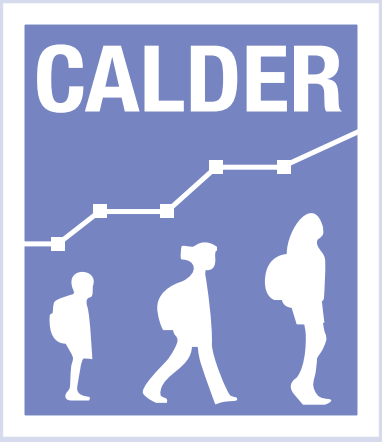
Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another school, "non-structural" move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing "structural" move, mean age and class size.

Table 22
Estimates of the Effects of NBPTS-Certified Teachers on Student Achievement: Full Sample versus NBPTS-Eligible Teachers, With and Without Controls for Experience and Advanced Degrees Using FCAT-NRT Scores (Self-Contained and Math or Reading/Language Arts Classes, Grades 3-10, 2000/01-2003/04)

	Math			Reading		
	Full Sample	NBPTS Eligible Teachers	NBPTS Eligible Teachers	Full Sample	NBPTS Eligible Teachers	NBPTS Eligible Teachers
Ever NBPTS Certified × Pre-Application Period	0.0126 (0.84)	0.0209 (0.99)	0.0202 (0.96)	-0.0038 (0.26)	0.0054 (0.25)	0.0030 (0.14)
Ever NBPTS Certified × Application Year	-0.0057 (0.32)	0.0101 (0.45)	0.0099 (0.44)	-0.0111 (0.70)	-0.0163 (0.71)	-0.0176 (0.76)
Ever NBPTS Certified × Received Certification	0.0024 (0.19)	0.0096 (0.56)	0.0112 (0.66)	0.0011 (0.11)	-0.0001 (0.19)	-0.0012 (0.08)
1-2 Years of Experience	0.0355*** (4.12)			0.0148* (1.85)		
3-4 Years of Experience	0.0409*** (4.17)			0.0136 (1.48)		
5-9 Years of Experience	0.0466*** (5.09)	0.0074 (0.76)		0.0154* (1.79)	-0.0001 (0.01)	
10-14 Years of Experience	0.0564*** (6.04)	0.0167 (1.60)		0.0249*** (2.85)	0.0139 (1.37)	
15-24 Years of Experience	0.0538*** (5.98)	0.0132 (1.32)		0.0250*** (2.98)	0.0101 (1.04)	
25 or More Years of Experience	0.0475*** (4.88)	0.0119 (1.08)		0.0330*** (3.58)	0.0182* (1.69)	
Advanced Degree	0.0058 (1.39)	0.0018 (0.29)		-0.0003 (0.08)	0.0054 (0.87)	
Student Time-Varying Char.	Yes	Yes	Yes	Yes	Yes	Yes
Peer Characteristics	Yes	Yes	Yes	Yes	Yes	Yes
Student Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
School Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
R-squared	0.620	0.697	0.697	0.641	0.720	0.720
No. of Student-Year Obs.	1,449,310	1,030,793	1,030,794	1,707,256	1,186,310	1,186,311

Note: Absolute values of t-ratios clustered at the classroom level appear in parentheses. * indicates statistical significance at .10 level, **indicates significance at the .05 level and *** indicates significance at the .01 level in a two-tailed test. All models include grade-by-year dummies and a constant. Included time-varying student characteristics are: number of schools attended in current year, "structural" move from another

school, “non-structural” move from another school. Included peer characteristics are: proportion female, proportion black, proportion undergoing “structural” move, mean age and class size.


CALDER