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# National Board Certification

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Impact on Teacher Effectiveness

October 2010



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## National Board Certification Report

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October, 2010

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## EXECUTIVE SUMMARY

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Research suggests that teacher quality makes a difference in students' academic achievement. Ultimately, National Board Certification is supposed to recognize quality educators and such quality should be evident through the academic achievement of their students. Current analyses of CMS data on National Board Certification show that, in line with past studies, National Board Certified Teachers (NBCTs) have a slight positive advantage over non-certified teachers, but that the effect size is small (CEPR, 2009). However, that analysis examined only 4<sup>th</sup>-8<sup>th</sup> grades. In this study, we extend these same analyses to our high school EOC courses. Additionally, no research to date has examined the impact of different certification types. In particular, we are interested in exploring the impact of those certifications that align with our North Carolina End of Grade (EOG) and End of Course (EOC) tests. Finally, we examine the student achievement for 3 year cohorts of NBCTs before, during, and after certification to explore the relationship between certification and teacher effectiveness in our district.

### **Why we used a value added model to compare National Board Certified Teachers to other teachers.**

Student and teacher data from 1998-1999 to 2008-2009 were obtained from the CMS longitudinal data files. On average, NBCTs have more years of experience, teach higher achieving students, and have fewer minority students. In order to separate the impact of National Board Certification from these factors, we used a value-added model in which we calculated a teacher's effect on student achievement growth by isolating teacher factors, specifically National Board Certification, from other factors (e.g., students' prior achievement, classroom and school effects, and other observable characteristics of the student).

### **National Board Certified Teachers are significantly more effective for some EOC courses.**

We found that NBCTs were significantly more effective (by .07-.10 of a standard deviation, the equivalent of 12-18 more days of instruction) than their non-NBCT counterparts in several EOC tested courses (Algebra II, Biology, Civics and Economics, Chemistry, and Geometry), while no differences were found between teacher type on others (e.g., English I, Algebra I). These are fairly large differences, particularly in comparison to what has been found in other research on National Board Certification. We would like to offer several possible explanations for these findings. First, maybe it is the case that teacher effectiveness in those classes in which NBCTs significantly outperformed non-NBCTs hinges on knowledge of subject matter (the basis of National Board Certification), whereas teacher effectiveness in those EOC courses in which NBCTs did not differ significantly from non-NBCTs is due a combination of other factors (e.g., classroom management, ability to engage students) that are not enhanced by National Board Certification. These larger effects for some EOC tested subjects may also be an artifact of the way in which pretest scores are calculated for EOCs (i.e., using the same approach that NCDPI uses to calculate growth). It may be the case that we were better able to control for prior achievement in some EOC tested courses than others. Since NBCTs generally teach higher performing students than non-NBCTs, not being able to effectively control for prior achievement may inflate estimates of their effectiveness.

### **Are NBCTs with those certifications that align with the subject matter they teach more effective than non-NBCTs and NBCTs with more general certification?**

Given our small sample size when we drilled down to certification level, we don't yet have a satisfactory answer to this question. For Math we found that NBCTs with 'Middle Childhood Generalist' and 'Math-Early Adolescence' certifications were slightly more effective (by .02 and .04 standard deviations, or 3.6 and 5.4 more days of instruction respectively) than non-NBCTs, but that there is no significant difference in effectiveness between NBCTs with these two certifications. For Reading, we found that students of NBCTs with the English Language Arts-Early Adolescence certification performed slightly better (by .02 of a standard deviation, or 3.6 more days of instruction) than non-NBCTs, but that NBCTs with this certification were not more effective than NBCTs with the 'Middle Childhood Literacy' certification. So while NBCTs with math or reading specific certifications were slightly more effective than non-NBCTs, students of NBCTs with math or reading specific certification didn't outshine students of other NBCTs on the math or reading EOG.

### **Teacher effectiveness before, during, and after earning National Board Certification.**

Finally, we explored teacher effectiveness before, during, and after earning National Board Certification. Researchers have asserted that while National Board Certification may identify more effective teachers, certification does not improve effectiveness (Harris & Sass, 2009). However, when we compared NBCTs prior to certification to non-NBCTs, we found no difference in effectiveness in Reading or Math, implying that, in CMS, NBCTs are not more effective than non-NBCTs prior to certification. Our findings regarding whether certification improves effectiveness are not conclusive. NBCTs after certification are more effective than non-NBCTs in math but not in reading. Another topic of interest to researchers is whether performance of NBCTs "dips" while they are in the process of applying for certification. We found that NBCTs did not differ significantly from non-NBCTs in Reading or Math during the application process.



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## INTRODUCTION

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National Board Certification is a voluntary certification process developed and managed by the National Board for Professional Teaching Standards (NBPTS), a nonprofit, nongovernmental organization comprised of classroom teachers, policy makers, and academic and corporate leaders (NBPTS, 2009). The mission of NBPTS is to: 1) maintain high and rigorous standards for what accomplished teachers should know and be able to do; 2) provide a national voluntary system for certifying teachers who meet those standards; and 3) advocate education reforms to integrate National Board Certification and to capitalize on the expertise of National Board Certified Teachers (NBCTs). The goal of National Board Certification is to “recognize experienced educators for the quality of their practice” (NBPTS pg v., 2009).

To this end, NBPTS espouses “Five Core Propositions” of what teachers should know and be able to do. First, teachers should be committed to students and their learning. Second, teachers should know the subjects they teach and how to teach those subjects to students. Teachers should be responsible for managing and monitoring student learning and they should think systematically about their practice and learn from experience. Finally, teachers should be members of learning communities. The standards and assessments for all NBPTS certification areas are based on these core propositions. The assessment process includes two major components: portfolios of classroom practice and assessment of content knowledge. Eligible teachers (those with a bachelor’s degree, three years of teaching experience, and a valid state teaching license) must develop four portfolio entries, three of which are classroom based and one which must demonstrate work with families, colleagues, and the larger community. For the assessment of content knowledge, candidates must respond to six computer based exercises pertaining to his or her area of expertise (NBPTS, 2009).

For each certification area, NBPTS has laid out standards which “represent a professional consensus on the unique aspects of practice that distinguish accomplished teachers in that field” (NBPTS pg 1-3, 2009b). These standards are grounded in the Five Core Propositions. Rubrics, derived from these standards are then used to score candidates’ portfolio and content knowledge entries. National Board assessors score all portfolio and content knowledge entries on a 12 point scale. Weights are then applied to each of the 10 components and a Total Weighted Scale Score of 275 is required to achieve National Board Certification. If candidates do not meet the required weighted scale score, they have the option to retake one or more of the 10 components (NBPTS, 2009b).

As of 2007, approximately 99,300 teachers had applied for National Board Certification and 63,800 had received it. The number of applicants per year increased from 540 in 1993 to 12,200 in 2007 (Hakel et al., 2008). Not surprisingly, there are higher concentrations of NBCTs in states that provide financial assistance to teachers wishing to pursue certification. North Carolina has the highest number of NBCTs (14,211) followed by Florida (12,670), South Carolina (6,498), and California (4,240) (NBPTS, 2009c). North Carolina also offers financial rewards in the form of a 12% salary increase to teachers who achieve National Board Certification. Given the significant investment of financial resources, the personal investment put in by teachers to complete the rigorous process of becoming National Board Certified, and the growing body of research linking high quality teaching to student success (e.g., Sanders and Rivers, 1996), understanding the impact of National Board Certification on student achievement is of utmost importance.

## Impact of National Board Certification on Student Achievement

Research suggests that teacher quality makes a difference in students' academic achievement. Ultimately, National Board Certification is supposed to recognize quality educators and such quality should be evident through the academic achievement of their students. Several large scale studies have tested this hypothesis by comparing student scores on state standardized tests for students of NBCTs and non-NBCTs. Several such studies (Cantrell et al., 2008; Clotfelter, Ladd, & Vigdor, 2007; Cavalluzzo, 2004; Goldhaber & Anthony, 2007; Harris & Sass, 2009) compared student achievement for NBCTs, future NBCTs (at the time of analysis they were not certified, but they would get certified later), never certified teachers, and (in some cases) teachers who attempted to get certification but did not achieve it. A number of interesting findings came from these studies. To begin with, for the most part NBCTs have little to no impact on student achievement beyond that of non-NBCTs. Effect sizes range from .01-.07 standard deviation units. In addition, the more rigorous studies (i.e., those with random assignment of classrooms to teachers or controls for student and classroom clustering effects) had smaller effect sizes (Cantrell et al., 2008, Clotfelter, Ladd & Vigdor, 2007; Harris & Sass, 2009; Sanders, Ashton, & Wright 2005).

Several interesting findings also emerged when teachers were examined by certification status. Those studies that examined the impact of teachers who attempted to get certification but did not achieve it found that the students of these teachers generally performed worse than the students of non-certified comparison teachers, though effect sizes were small (Cantrell et al., 2008; Cavalluzzo, 2004; Goldhaber & Anthony, 2007). It is also not clear what impact the actual application process has on applicants' students' achievement. On the one hand, small gains have been observed in some studies (e.g., Cavalluzzo, 2004), implying that the process of learning and self reflecting during certification has a small positive impact. Conversely, other studies (e.g., Goldhaber & Anthony, 2007) have found that students of teachers going through the certification process actually make lower gains, implying that the time that it takes to complete the application process may actually be detrimental to those teachers' students.

Finally, in the studies in which longitudinal datasets allowed researchers to identify teachers *before* they attained certification (i.e., future NBCTs), results showed that these future NBCTs were more effective than current NBCTs or NBCTs who have had their certification for some time (Clotfelter, Ladd & Vigdor 2007; Goldhaber & Anthony, 2007). Further, the one study that was able to compare the student achievement of the same teachers over time found that teacher performance did not improve significantly over time- before, during, and after certification (Harris & Sass, 2009). These findings suggest that while National Board Certification may identify more effective teachers, certification does not improve effectiveness.

### *Purpose*

Current analyses of CMS data on National Board Certification show that, in line with past studies, NBCTs have a slight positive advantage over non-certified teachers, but that the effect size is very small (CEPR, 2009). However, this analysis examined only 4<sup>th</sup>-8<sup>th</sup> grades. We would like to extend these same analyses to our high school EOC courses. Additionally, no research to date has examined the impact of different certification types. In particular, we are interested in exploring the impact of those certifications that align with our North Carolina End of Grade (EOG) and End of Course (EOC) tests. Finally,

we would like to examine the student achievement for 3 year cohorts of NBCTs before, during, and after certification to explore the relationship between certification and teacher effectiveness in our district.

### ***Evaluation Questions***

1. What is the impact of National Board Certification on student achievement in EOC tested courses?
  - a. What impact does certification type have on student achievement?
  - b. Does student academic achievement differ between NBCTs with different types of National Board Certification?
2. Do students of NBCTs with specific types of certification outperform students of comparison teachers?
3. How does the student achievement before, during, and after certification compare for teachers who received National Board Certification?

## METHOD

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### *Data*

Student and teacher data from 1998-1999 to 2008-2009 were obtained from the CMS longitudinal data files. These files link students to teachers and both students and teachers are tracked over time. National Board Certification information was provided by the CMS office of professional development (Table 1). Certification information was available from 1999 through 2007. In total, 1056 teachers earned National Board Certification in these years. The most frequently obtained National Board Certifications were Early Childhood Generalist (n=248) and Middle Childhood Generalist (n=198), though Early and Middle Childhood Literacy has been popular in the last 4 years (n=43). Teachers were classified as National Board certified, the school year *after* they were reported by professional development to have received their certification.

Appendix A provides student, teacher, and school level descriptives for NBCTs and non-NBCTs by tested subject. Table 2 shows that, in general, across EOG and EOC tested courses, NBCTs taught classes with a higher percentage of white students than non-NBCTs (54% vs. 38% weighted average across EOG and EOC tested courses). NBCTs and non-NBCTs taught about the same percentage of LEP students (6% vs. 7%). NBCTs taught a higher percentage of gifted students (23% vs. 12%), a lower percentage of EC students (9% vs. 16%), and a slightly lower percentage of retained students (3% vs. 4%). NBCTs taught at schools with a higher percentage of white students (47% vs 36%), a similar percentage of LEP students (8% vs. 9%), a similar percentage of EC students (9% vs. 10%), and a higher percentage of gifted students (19% vs 14%). On average, students taught by NBCTs scored 0.4 standard deviations higher on standardized tests than students taught by non-NBCTs ( $z = .23$  vs.  $z = -.21$ ). NBCTs taught in schools that scored, on average, about a quarter of a standard deviation higher on standardized tests than schools in which non-NBCTs taught  $z = .16$  vs.  $z = -.09$ ). Students taught by NBCTs generally had fewer average behavioral incidents per pupil than students taught by non-NBCTs (.35 vs. .59). Finally, approximately 84% of NBCTs and approximately 69% of non NBCTs were white. On average NBCTs had approximately 5 more years of experience than non-NBCTs (14 vs. 9 years). In sum, it appears the NBCTs teach a more advantaged student population than other teachers in CMS.

**Table 1. Types of National Board Certifications Earned by Year.**

| Type of Certification                                | 1999      | 2000      | 2001      | 2002      | 2003       | 2004       | 2005       | 2006       | 2007       | 2008       | Total       |
|--|-----------|-----------|-----------|-----------|------------|------------|------------|------------|------------|------------|-------------|
| Counseling   | 0         | 1         | 0         | 0         | 0          | 9          | 11         | 11         | 5          | 8          | 45          |
| Library/Media  | 0         | 0         | 0         | 8         | 2          | 3          | 2          | 3          | 7          | 9          | 34          |
| World Languages                                      | 0         | 0         | 0         | 1         | 6          | 3          | 1          | 4          | 0          | 3          | 18          |
| <b>Early Childhood (3-8 yrs old)</b>                 |           |           |           |           |            |            |            |            |            |            |             |
| Generalist   | 20        | 10        | 15        | 15        | 29         | 27         | 20         | 35         | 40         | 37         | 248         |
| <b>Early and Middle Childhood (3-12 yrs old)</b>     |           |           |           |           |            |            |            |            |            |            |             |
| English as a New Language                            | 0         | 2         | 2         | 0         | 1          | 1          | 3          | 3          | 2          | 5          | 19          |
| Art  | 0         | 0         | 2         | 2         | 2          | 5          | 3          | 0          | 3          | 2          | 19          |
| Physical Education                                   | 0         | 0         | 7         | 0         | 6          | 3          | 5          | 1          | 4          | 1          | 27          |
| Music  | 0         | 0         | 0         | 7         | 0          | 2          | 1          | 4          | 0          | 1          | 15          |
| Literacy   | 0         | 0         | 0         | 0         | 0          | 4          | 8          | 10         | 11         | 10         | 43          |
| <b>Middle Childhood (7-12 yrs old)</b>               |           |           |           |           |            |            |            |            |            |            |             |
| Generalist   | 11        | 11        | 17        | 17        | 20         | 29         | 20         | 23         | 23         | 27         | 198         |
| <b>Early Adolescence (11-15 yrs old)</b>             |           |           |           |           |            |            |            |            |            |            |             |
| Generalist   | 2         | 1         | 0         | 0         | 1          | 0          | 0          | 0          | 0          | 0          | 4           |
| English/Language Arts                                | 1         | 4         | 6         | 2         | 1          | 4          | 2          | 2          | 5          | 10         | 37          |
| Math   | 2         | 0         | 0         | 1         | 5          | 5          | 5          | 6          | 6          | 1          | 31          |
| Science  | 2         | 2         | 5         | 1         | 0          | 0          | 0          | 1          | 2          | 2          | 15          |
| Social Studies/History                               | 5         | 2         | 1         | 4         | 2          | 3          | 4          | 3          | 4          | 1          | 29          |
| <b>Early Adolescence/Young Adult (11-18 yrs old)</b> |           |           |           |           |            |            |            |            |            |            |             |
| Art  | 1         | 2         | 4         | 2         | 0          | 2          | 1          | 1          | 2          | 4          | 19          |
| English/Language Arts                                | 0         | 0         | 0         | 0         | 0          | 0          | 0          | 0          | 0          | 1          | 1           |
| Career and Technical Education                       | 0         | 3         | 3         | 5         | 6          | 12         | 8          | 5          | 5          | 4          | 51          |
| English as a New Language                            | 0         | 1         | 0         | 0         | 0          | 0          | 0          | 2          | 4          | 2          | 9           |
| Physical Education                                   | 0         | 0         | 1         | 2         | 1          | 0          | 1          | 1          | 3          | 2          | 11          |
| Music  | 0         | 0         | 0         | 4         | 1          | 2          | 4          | 1          | 1          | 2          | 15          |
| <b>Adolescence and Young Adult (14-18 yrs old)</b>   |           |           |           |           |            |            |            |            |            |            |             |
| English/Language Arts                                | 6         | 4         | 3         | 2         | 5          | 3          | 6          | 2          | 5          | 5          | 41          |
| Math   | 6         | 3         | 1         | 2         | 3          | 3          | 0          | 2          | 1          | 2          | 23          |
| Science  | 2         | 4         | 5         | 0         | 0          | 3          | 2          | 0          | 3          | 2          | 21          |
| Social Studies/History                               | 1         | 3         | 2         | 1         | 5          | 4          | 5          | 3          | 0          | 4          | 28          |
| <b>Early Childhood-Young Adult (3-18 yrs old)</b>    |           |           |           |           |            |            |            |            |            |            |             |
| Exceptional Needs Specialist                         | 0         | 4         | 7         | 6         | 6          | 5          | 4          | 10         | 4          | 9          | 55          |
| <b>Total National Board Teachers Certified</b>       | <b>59</b> | <b>57</b> | <b>81</b> | <b>82</b> | <b>102</b> | <b>132</b> | <b>116</b> | <b>133</b> | <b>140</b> | <b>154</b> | <b>1056</b> |

**Table 2. Descriptive Statistics for National Board Certified and non-National Board Certified Teachers.**

| Descriptive Variables            | Non-National Board Certified Teachers |        |                | National Board Certified Teachers |        |                | Difference |
|----------------------------------|---------------------------------------|--------|----------------|-----------------------------------|--------|----------------|------------|
|                                  | N                                     | Mean   | Std. Deviation | N                                 | Mean   | Std. Deviation |            |
| Number of students               | 19,257                                | 55.14  | 30.84          | 1,202                             | 61.97  | 32.38          | 6.83***    |
| Percent White                    | 19,745                                | 37.60% | 27.22%         | 1,250                             | 53.79% | 27.97%         | 16.19%***  |
| Standardized test z-score        | 29,423                                | -0.21  | 0.68           | 2,331                             | 0.23   | 0.64           | 0.44***    |
| Percent LEP                      | 19,745                                | 7.38%  | 13.09%         | 1,250                             | 6.06%  | 12.03%         | -1.32%**   |
| Percent Gifted                   | 19,745                                | 12.29% | 15.71%         | 1,250                             | 23.04% | 19.75%         | 10.75%***  |
| Percent EC                       | 19,745                                | 15.49% | 25.95%         | 1,250                             | 9.30%  | 17.48%         | -6.19%***  |
| Percent Retained                 | 18,194                                | 4.18%  | 9.29%          | 1,239                             | 2.74%  | 7.04%          | -1.44%***  |
| School Percent White             | 28,769                                | 35.69% | 25.88%         | 2,306                             | 47.29% | 27.14%         | 11.60%***  |
| School Percent LEP               | 28,769                                | 8.84%  | 8.86%          | 2,306                             | 8.26%  | 8.79%          | -0.58%**   |
| School Percent EC                | 28,769                                | 9.97%  | 6.79%          | 2,306                             | 9.10%  | 5.66%          | -0.87%***  |
| School Percent Gifted            | 28,769                                | 13.52% | 11.09%         | 2,306                             | 18.96% | 13.06%         | 5.44%***   |
| School standardized test z-score | 28,321                                | -0.09  | 0.48           | 2,264                             | 0.16   | 0.50           | 0.2503***  |
| Number of behavior incidents     | 10,170                                | 0.59   | 1.02           | 1,129                             | 0.35   | 0.70           | -0.24***   |
| Teacher Percent White            | 29,249                                | 69.07% | 46.22%         | 2,330                             | 84.46% | 36.23%         | 15.39%***  |
| Teacher Years of Experience      | 29,401                                | 8.93   | 9.22           | 2,331                             | 14.34  | 8.01           | 5.4092***  |

### Model

As illustrated in Table 2, National Board Certified Teachers have more years of experience, teach higher achieving students, and have fewer minority students. In order to separate the impact of National Board Certification from these factors, we used a value-added model in which we calculated a teacher's effect on student achievement growth by isolating teacher factors, specifically National Board Certification, from other factors (e.g., students' prior achievement, classroom and school effects, and other observable characteristics of the student). Teacher effects are calculated using the following student-level equation:

$$A_{ijkt} = \alpha A_{ijk,t-1} + S_{it,t-1} \beta + P_{-ijkt,t-1} \delta + \gamma NBCT_{kt} + YRS_{kt} + X_{kt} + \varepsilon_{ijkt}$$

where the outcome variable, A, refers to the standardized test score (EOG or EOC, depending on the particular analysis) for student *i*, in class *j*, taught by teacher *k*, during school year *t*; S is a vector of student observable characteristics from the prior and current year, P is a matrix of peer, school and classroom characteristics from the current and prior years, X is a vector of school by grade by year fixed

effects and  $\epsilon$  is a random error term; and YRS indicates the teacher's years of experience. The parameter of interest is  $\gamma$ , the impact of NBCT certification (or type of certification depending on the analyses).

In order to assess student achievement of NBCTs before, during, and after certification, certification status (ranging from 4 years prior to 4 years post certification) was included as a teacher characteristic. We then divided NBCTs into three categories: pre-certification (4 years prior through 3 years prior), application years (2 years prior through 1 year prior) and post-certification (0 through 4 years post) and, utilizing the same model outlined above, calculated teacher effects for each category (pre-certification, application years, and post-certification) of NBCTs in comparison to non-NBCTs.

Effectiveness in value added research is usually measured in effect sizes, or standard deviation units. In order to express effectiveness in a way that policymakers can more easily understand, we translate effect sizes into a 'days of instruction' metric. This days of instruction metric begins with the assumption that by definition the average students with the average teacher grows one year (180 school days) each year, which corresponds to an effect size of 0.0. Students with more effective teachers make more than a year's worth of growth. So a teacher with an effect size of 0.15 standard deviations of a test score is 15% more effective than the average teacher in the same 180 days. Therefore we can say that this more effective teacher provides the equivalent to an extra 27 days of instruction (15% of 180). Both effect sizes and days of instruction are utilized as measures of the magnitude of teacher differences in the following analyses.

### *Assumptions*

Several assumptions relating to these analyses should be stated. Firstly, because we were not able to randomly assign students to teachers, we are assuming that the many control variables (at the student, classroom, school, and teacher level) are able to capture all of the systematic variation between the students of NBCT and non-NBCT teachers. However, it is possible that systematic differences exist between these teachers that we are not able to account for (e.g., if some sort of systematic sorting of students occurs between NBCT and non NBCT teachers in a way that favors one group or the other) and could bias our estimates of the effect of NBCT.

The method in which pre-test scores were calculated at the EOC level is another possible threat to validity. These scores were calculated using the same tests or test combinations used by the North Carolina Department of Public Instruction (NCDPI) to calculate growth scores (NCDPI, 2009). Some EOC pretest calculations use more recent tests as pretests than others. For example, math EOG scores are used as pretest scores for Algebra I. Assuming most students take Algebra I in 8<sup>th</sup> or 9<sup>th</sup> grade, this is a fairly close (in terms of time between tests) pretest score. In contrast, to calculate a pretest score for US History, one must either use a combination of Civics and Economics and English I scores, or Biology scores depending on which are available. Depending on a student's progress through the high school curriculum, some of these pretests may be taken 2-3 years before the post test. There is also a greater discrepancy in subject matter between these pretests and post test to which they are supposed to predict. However, it should be noted that the same pre-test calculations are used for students of both NBCT and non-NBCTs. Therefore, though the method of calculating pre-test scores may be more "noisy" for some EOCs than others, we do not expect that there is any systematic bias between groups

(NBCT vs. non-NBCT) unless one group taught students who systematically had gone longer between the tests. We attempt to control for any bias that could result by controlling for the students' age and grade.

Finally, to explore the impact of using different sets of control variables in our model, we tested several different models with different control variable specifications for each research question. Appendix A displays findings for each EOC analysis, testing several models with different specifications. We tested the sensitivity of our findings to various combinations of student, class and school-level controls, as well as student and school fixed effects models. We also tested our results using a gainscore. Full tables for each specification are available upon request. In general, we found similar results across model types, but we report findings from the analysis employing the most stringent controls.

## RESULTS

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### Impact of National Board Certification on student achievement in EOC tested courses

Table 4 shows the effect of National Board Certification on student achievement (measured in standard deviation units) in EOC tested courses, holding constant student, peer, teacher and school characteristics (See Appendix A for all models examined). No significant differences between students taught by NBCTs vs. those taught by non-NBCTs were found for Algebra I, English I, Physics, Physical Science, or US History. NBCTs were significantly more effective (with differences ranging from .07 to .10 of a standard deviation, or 12-18 more days of instruction) than non-NBCTs in Algebra II, Biology, Civics and Economics, Chemistry, and Geometry. The findings were consistent whether we estimated the results using a teacher's current status as NBCT (first row of Table 4) or an indicator of whether they were ever NBCT. However, the magnitude of the findings changed when we compared teachers who were ever certified NBCT with the never-NBCT within the same school. Controlling for these across school differences increased the positive impact of being the ever-NBCT significantly in Civic, Chemistry and US History. It changed the sign of the impact in Physics: within the same school, ever-NBCTs were less effective than never-NBCTs by a substantial amount. It should be noted that samples were quite small for Physics, Civics and Economics and Physical Science, with less than 15 NBCTs teaching in each of these courses. Results for these subjects should be interpreted with caution.

<sup>1</sup> These variables include the cubic of up to two prior test scores, the student's gender, ethnicity designation as academically gifted, age, LEP status, special education status, proportion of days absent in prior year, proportion of days spend in out-of-school and in-school suspension in previous year, repetition of a grade, first year in school, and the number of moves between schools in a current year. Because prior to 2007, we cannot reconstruct actual classrooms in the data, we use means of the students taught by the teacher in a given year as a proxy. These means include all of the student level variables aggregated to the teacher level. In addition, we control for the class size. Finally, we include these same variables but aggregated to the school level. We also include the school's size and proportion of economically disadvantaged students.



Table 4. Estimates of the effects of National Board certified EOC teachers

|                                   | Algebra I            | Algebra II             | Biology                | Civics                | Chemistry            | English I          | Geometry              | Physics              | Physical Sci        | US History           |
|-----------------------------------|----------------------|------------------------|------------------------|-----------------------|----------------------|--------------------|-----------------------|----------------------|---------------------|----------------------|
| Currently NBCT                    | 0.0324<br>(0.0205)   | 0.0881***<br>(0.0190)  | 0.0986***<br>(0.0175)  | 0.0746*<br>(0.0307)   | 0.0977**<br>(0.0318) | 0.0164<br>(0.0169) | 0.0942***<br>(0.0207) | 0.0132<br>(0.0526)   | -0.0545<br>(0.0620) | 0.0496<br>(0.0335)   |
| Ever NBCT                         | 0.0216<br>(0.0181)   | 0.0946***<br>(0.0162)  | 0.0789***<br>(0.0156)  | 0.0967***<br>(0.0269) | 0.130***<br>(0.0285) | 0.0247<br>(0.0149) | 0.0867***<br>(0.0183) | -0.0378<br>(0.0503)  | -0.0545<br>(0.0620) | 0.0596<br>(0.0311)   |
| Ever NBCT within Same School      | 0.00228<br>(0.00844) | 0.0769***<br>(0.00877) | 0.0755***<br>(0.00776) | 0.131***<br>(0.0128)  | 0.144***<br>(0.0139) | 0.0114<br>(.)      | 0.0863***<br>(0.0101) | -0.102**<br>(0.0372) | -0.0819<br>(0.0617) | 0.122***<br>(0.0132) |
| Observations                      | 53079                | 39817                  | 49924                  | 30423                 | 26234                | 61562              | 48019                 | 6274                 | 6022                | 28885                |
| Adjusted R-squared                | 0.682                | 0.694                  | 0.664                  | 0.695                 | 0.644                | 0.714              | 0.747                 | 0.718                | 0.501               | 0.587                |
| Total Unique Number of Teachers   | 703                  | 309                    | 324                    | 201                   | 154                  | 530                | 402                   | 65                   | 99                  | 192                  |
| Total Unique NBCT Teachers        | 47                   | 29                     | 30                     | 14                    | 17                   | 34                 | 31                    | 8                    | 5                   | 18                   |
| Total Unique Non-NBCT Teachers    | 675                  | 291                    | 304                    | 190                   | 141                  | 506                | 381                   | 60                   | 94                  | 179                  |
| Total Students with NBCT Teachers | 4211                 | 4751                   | 6174                   | 1842                  | 3847                 | 5685               | 3008                  | 1598                 | 449                 | 4958                 |
| Total Students w/o NBCT Teachers  | 48868                | 35066                  | 43750                  | 28581                 | 22387                | 55877              | 45011                 | 4676                 | 5573                | 23927                |
| Minimum Year in Sample            | 2001                 | 2003                   | 2002                   | 2006                  | 2003                 | 2001               | 2001                  | 2003                 | 2002                | 2002                 |
| Maximum Year in Sample            | 2009                 | 2009                   | 2009                   | 2009                  | 2009                 | 2009               | 2009                  | 2009                 | 2009                | 2009                 |
| Grades in Sample                  | 8-12                 | 8-12                   | 9-12                   | 9-12                  | 9-12                 | 9-12               | 8-12                  | 9-12                 | 9-12                | 9-12                 |

Note: Presents results from three separate regressions. The first regression (row 1) defines NBCT as those teachers currently certified. The second regression (row 3) defines NBCT as those teachers who ever were NBCT during the sample period. The third regression (row 5) compares the effects of those teacher who were ever certified as NBCT with those who were never certified within the same schools. Models control for the cubic of up to two prior test scores, the student's gender, ethnicity designation as academically gifted, age, LEP status, special education status, proportion of days absent in prior year, proportion of days spend in out-of-school and in-school suspension in previous year, repetition of a grade, first year in school, and the number of moves between schools in a current year. Because prior to 2007, we cannot reconstruct actual classrooms in the data, we use means of the students taught by the teacher in a given year as a proxy. These means include all of the student level variables aggregated to the teacher level. In addition, we control for the class size. Finally, we include these same variables but aggregated to the school level. We also include the school's size and proportion of economically disadvantaged students. We also include controls for teacher experience, grade by year fixed effects. Robust standard errors clustered by school by grade by year are included in parentheses.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

## Impact of certification type on student achievement

The impact of certification type was assessed in two ways. First we examined whether students of NBCTs with specific certification types outperformed students of non NBCTs. To be included in the analyses, we required that there be 15 unique teachers with a specified certification teaching an EOG/EOC tested course. For the Reading EOG, we compared teachers with the following certifications to non-NBCTs: ‘Middle Childhood Generalist’, ‘Early Adolescence-English Language Arts’, ‘Early Childhood Generalist’, and ‘Middle Childhood Literacy’. For the Math EOG, we compared teachers with the following certifications to non-NBCTs: ‘Middle Childhood Generalist’, ‘Early Childhood Generalist’, and ‘Early Adolescence-Math’. At the EOC level, only 4 subjects (Algebra I, Algebra II, English I, and US History) had enough teachers (>15) with a specific type of certification to be examined. For Algebra I we examined NBCTs with the ‘Early Adolescence-Math’ certification, for English I we looked at those with the ‘English Language Arts-Early Adolescence’ certification, for Algebra II we looked at those with the ‘Adolescence and Young Adult-Math’ certification, and for US History we looked at those with the ‘Adolescence and Young Adult-Social Studies/History’ certification.

Results of our first analysis (teachers with specific certifications vs. non-NBCTs) showed that of the five types of certified teachers compared to non-certified teachers, there was one statistically significant difference in Reading EOG performance. Students of NBCTs with the Early Adolescence-English Language Arts certification performed slightly better (by .02 of a standard deviation, or 3.6 more days of instruction) than non-NBCTs. Of the three types of certified teachers compared to non-certified teachers, there were two statistically significant differences in Math EOG performance. Students of NBCTs with the ‘Middle Childhood Generalist’ certification performed slightly better (by .03 of a standard deviation, or 5.4 more days of instruction) than non-NBCTs, and students of NBCTs with the ‘Early Adolescence-Math’ certification also performed slightly better (by .04 of a standard deviation, or 7.2 more days of instruction) than non-NBCTs. Students of Algebra I NBCTs with the ‘Early Adolescence-Math’ certification did not differ significantly from non-NBCTs. Students of English I NBCTs with the ‘Early Adolescence-English Language Arts’ certification performed slightly better (by .04 of a standard deviation, or 7.2 more days of instruction) than students of non-NBCTs. Students of Algebra II NBCTs with the ‘Adolescence and Young Adult-Math’ certification and students of US History NBCTs with the ‘Adolescence and Young Adult -Social Studies/History’ certification also outperformed (by .07 and .08 of a standard deviation, or 12.6 and 14.4 more days of instruction, respectively) students of non-NBCTs after controlling for teacher experience, student level variables, classroom level variables, and school level variables. Table 5 shows estimated effects by subject and certification type.

**Table 5. Estimated Effects of Specific Types of National Board Certifications  
in Comparison to Non-certified Teachers**

| Type of National Board Certification                | Tested Subject         |                      |                    |                     |                      |                     |
|---|------------------------|----------------------|--------------------|---------------------|----------------------|---------------------|
|   | Math                   | Reading              | Algebra I          | English I           | Algebra II           | US History          |
| Middle Childhood Generalist                         | 0.0293***<br>(0.00721) | 0.0116<br>(0.00599)  |                    |                     |                      |                     |
| Early Childhood Generalist                          | -0.0258<br>(0.0321)    | -0.0345<br>(0.0239)  |                    |                     |                      |                     |
| Early and Middle Childhood Literacy                 | -0.0222<br>(0.0236)    | -0.0126<br>(0.0188)  |                    |                     |                      |                     |
| Early Adolescence-Math                              | 0.0384**<br>(0.0136)   |                      | 0.0351<br>(0.0219) |                     |                      |                     |
| Early Adolescence- English<br>Language Arts         |                        | 0.0163*<br>(0.00734) |                    |                     |                      |                     |
| Adolescence/ Young Adult- English<br>Language Arts  |                        |                      |                    | 0.0493*<br>(0.0191) |                      |                     |
| Adolescence/Young Adult-Math                        |                        |                      |                    |                     | 0.0713**<br>(0.0220) |                     |
| Adolescence/Young Adult -<br>Social Studies/History |                        |                      |                    |                     |                      | 0.0810*<br>(0.0346) |

Note: Model controls for the cubic of up to two prior test scores, the student's gender, ethnicity designation as academically gifted, age, LEP status, special education status, proportion of days absent in prior year, proportion of days spend in out-of-school and in-school suspension in previous year, repetition of a grade, first year in school, and the number of moves between schools in a current year. Because prior to 2007, we cannot reconstruct actual classrooms in the data, we use means of the students taught by the teacher in a given year as a proxy. These means include all of the student level variables aggregated to the teacher level. In addition, we control for the class size. Finally, we include these same variables but aggregated to the school level. We also include the school's size and proportion of economically disadvantaged students. We also include controls for teacher experience, grade by year fixed effects. Robust standard errors clustered by school by grade by year are included in parentheses

\*\*\*=p<.001, \*\*=p<.01, \*=p<.05

Second we explored variation within National Board Certified Teachers. We examined whether student academic achievement differs *between* NBCTs with different types of certification. Because of the small number of NBCTs teaching EOC tested courses, we did not have enough teachers to disaggregate to the certification level for EOC teachers. Thus, only Reading and Math EOG achievement were examined. Again, we required that there be 15 unique teachers with a specified certification teaching an EOG tested course for these analyses. For Reading, we explored the variation in value added for those teachers with the ‘English Language Arts-Early Adolescence’ and ‘Middle Childhood Literacy’ certifications. For Math, we explored the variation in value added for those teachers with the ‘Middle Childhood Generalist’ and ‘Math-Early Adolescence’ certifications. For Math, we found no significant difference between those NBCTs with the ‘Middle Childhood Generalist’ certification and those with the ‘Math-Early Adolescence’ certification. For Reading, we found that NBCTs with the ‘Middle Childhood Literacy’ certification did not differ significantly from those with the ‘English Language Arts-Early Adolescence’ certification.

### Teacher effectiveness before, during, and after certification

To examine the effectiveness of NBCTs before, during, and after certification, we divided them into three categories: ‘pre-certification’ (4 years prior through 3 years prior), ‘application years’ (2 years prior through 1 year prior) and ‘post-certification’ (0 through 4 years post). We then calculated teacher effects for each category (pre-certification, application years, and post-certification) of NBCTs in comparison to non-NBCTs. Because of the small sample size at the EOC level, we conducted this analysis only for those teachers who taught EOG math and reading tested courses. As Table 6 illustrates, ‘pre-certification’ NBCTs and NBCTs in their ‘application years’ are no more or less effective than non-NBCTs as measured by the Math EOG. ‘Post-certification’ NBCTs are slightly more effective than non-NBCTs (by .03 of a standard deviation, or 5.4 more days of instruction) in math. We found no significant differences between ‘pre-certification’, ‘application years’ or ‘post-certification’ NBCTs and non-NBCTs in reading (Table 6).

**Table 6. Effectiveness of NBCTs vs. non-NBCTs over time.**

| Point in National Board Certification Process | Tested Subjects       |                      |
|---|-----------------------|----------------------|
|   | Math                  | Reading              |
| Pre Certification                             | 0.0101<br>(0.0152)    | 0.00922<br>(0.00977) |
| Application Years                             | 0.0182<br>(0.0117)    | 0.0109<br>(0.00940)  |
| Post Certification                            | 0.0255**<br>(0.00866) | 0.0102<br>(0.00688)  |
| Number of Student-Year Observations           | 271260                | 298226               |
| Adj. R-squared                                | 0.782                 | 0.747                |

Note: values in parentheses represent the standard errors for each coefficient.  
 \*\*\*=p<.001, \*\*=p<.01, \*=p<.05

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## DISCUSSION

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The goal of this analysis of National Board Certification was to extend the research that has already been conducted in the district on this topic. Specifically we explored the impact of National Board Certification in EOC tested courses, examined whether NBCT certification type influenced teacher effectiveness (for the few types of certification in which we had enough teachers to run the analyses), and looked at teacher effectiveness for NBCTs before, during, and after certification.

We found that NBCTs were significantly more effective than their non-NBCT counterparts in several EOC tested courses (Algebra II, Biology, Civics and Economics, Chemistry, and Geometry), while no differences were found between teacher type on others (e.g., English I, Algebra I). We would like to offer several possible explanations for these findings. First, maybe it is the case that teacher effectiveness in those classes in which NBCTs significantly outperformed non-NBCTs hinges on knowledge of subject matter (the basis of National Board Certification), whereas teacher effectiveness in those EOC courses in which NBCTs did not differ significantly from non-NBCTs is due a combination of other factors (e.g., , classroom management, ability to engage students) that are not enhanced by National Board Certification. These larger effects for some EOC tested subjects may also be an artifact of the way in which pretest scores are calculated for EOCs (i.e., using the same approach that NCDPI uses to calculate growth). It may be the case that we were better able to control for prior achievement in those EOC tested courses in which students likely took the pretest in the previous year (i.e., Algebra I and English I) than those in which a combination of scores, possibly from multiple years, comprised the pretest (e.g., , Biology). Similarly, it might be the case that using other subjects (i.e., English EOC scores are part of the pretest calculation for Biology) as a pretest measure does not effectively control for prior achievement in these subjects. Since NBCTs generally teach higher performing students than non-NBCTs, not being able to effectively control for prior achievement may inflate estimates of their effectiveness.

No studies to date have examined the effectiveness of NBCTs with different types of certification. Unfortunately, due to sample size restrictions, we were limited in our ability to explore this question. We were able to drill down to the certification level and compare NBCTs with specific certifications to non-NBCTs for Math, Reading, Algebra I, Algebra II, English I, and US History. To explore the differential effectiveness of certification type within National Board Certified Teachers, we only had enough teachers to examine the difference between two certification types for Math and two certification types for Reading. We were particularly interested in whether NBCTs with those certifications that align with the subject matter they teach (i.e., an NBCT with the “English Language Arts, Adolescence/Young Adult” certification who teaches English I courses) are more effective than non-NBCTs and NBCTs with more general certification or certification that does not align with the subject matter that they teach.

Given our small sample size when we drilled down to certification size, we don't yet have a satisfactory answer to this question. For Math we found that NBCTs with ‘Middle Childhood Generalist’ and ‘Math-Early Adolescence’ certifications were slightly more effective (by .02 and .04 standard deviations, or 3.6 and 5.4 more days of instruction respectively) than non-NBCTs, but that there is no significant

difference in effectiveness between NBCTs with these two certifications. So students of NBCT's with math specific certification didn't outshine students of other NBCTs on the math EOG. For Reading, we found that students of NBCTs with the English Language Arts-Early Adolescence certification performed slightly better (by .02 of a standard deviation, or 3.6 more days of instruction) than non-NBCTs, but that NBCTs with this certification were not more effective than NBCTs with the 'Middle Childhood Literacy' certification. So while NBCTs with math or reading specific certifications were slightly more effective than non-NBCTs, students of NBCTs with math or reading specific certification didn't outshine students of other NBCTs on the math or reading EOG.

Finally, we analyzed teacher effectiveness before, during, and after earning National Board Certification. Researchers have asserted that while National Board Certification may identify more effective teachers, certification does not improve effectiveness (Harris & Sass, 2009). However, when we compared NBCTs prior to certification to non-NBCTs, we found no difference in effectiveness in Reading or Math, implying that, in CMS, NBCTs are not more effective than non-NBCTs prior to certification. Our findings regarding whether certification improves effectiveness are not conclusive. NBCTs after certification are more effective than non-NBCTs in math but not in reading. Another topic of interest to researchers is whether performance of NBCTs "dips" while they are in the process of applying for certification. We found that NBCTs did not differ significantly from non-NBCTs in Reading or Math during the application process.

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**Appendix A. Descriptive Statistics for National Board Certified and non-National Board Certified Teachers by Subject Area.**

| Test Subject                   | Descriptive Variables          | Non-National Board Certified Teachers |         |         |        | National Board Certified Teachers |       |         |         |        |                |
|--------------------------------|--------------------------------|---------------------------------------|---------|---------|--------|-----------------------------------|-------|---------|---------|--------|----------------|
|                                |                                | N                                     | Minimum | Maximum | Mean   | Std. Deviation                    | N     | Minimum | Maximum | Mean   | Std. Deviation |
| Algebra I                      | Number of students             | 1,443                                 | 1.00    | 184.00  | 69.16  | 39.89                             | 70    | 7.00    | 127.00  | 63.10  | 31.24          |
|                                | Percent White***               | 1,443                                 | 0.00    | 1.00    | 0.35   | 0.24                              | 70    | 0.00    | 1.00    | 0.52   | 0.28           |
|                                | Algebra I z-score***           | 1,975                                 | -2.34   | 2.00    | -0.29  | 0.74                              | 125   | -1.29   | 1.92    | 0.20   | 0.80           |
|                                | Percent LEP                    | 1,443                                 | 0.00    | 1.00    | 0.06   | 0.08                              | 70    | 0.00    | 0.72    | 0.07   | 0.12           |
|                                | Percent Gifted**               | 1,443                                 | 0.00    | 0.73    | 0.08   | 0.12                              | 70    | 0.00    | 0.67    | 0.16   | 0.18           |
|                                | Percent EC*                    | 1,443                                 | 0.00    | 1.00    | 0.15   | 0.27                              | 70    | 0.00    | 1.00    | 0.08   | 0.21           |
|                                | Percent Retained               | 1,442                                 | 0.00    | 1.00    | 0.11   | 0.14                              | 70    | 0.00    | 0.46    | 0.09   | 0.13           |
|                                | School Percent White***        | 1,804                                 | 0.00    | 0.83    | 0.34   | 0.25                              | 121   | 0.00    | 0.82    | 0.51   | 0.27           |
|                                | School Percent LEP**           | 1,804                                 | 0.00    | 0.44    | 0.07   | 0.06                              | 121   | 0.00    | 0.27    | 0.05   | 0.05           |
|                                | School Percent EC**            | 1,804                                 | 0.00    | 1.00    | 0.11   | 0.11                              | 121   | 0.00    | 0.50    | 0.08   | 0.07           |
|                                | School Percent Gifted***       | 1,804                                 | 0.00    | 0.63    | 0.12   | 0.10                              | 121   | 0.00    | 0.64    | 0.18   | 0.14           |
|                                | School Algebra I z-score***    | 1,729                                 | -2.54   | 1.73    | -0.38  | 0.82                              | 115   | -2.54   | 1.73    | 0.13   | 0.90           |
|                                | Number of behavior incidents*  | 532                                   | 0.00    | 12.71   | 1.01   | 1.53                              | 55    | 0.00    | 2.27    | 0.59   | 0.59           |
|                                | Teacher Percent White***       | 1,957                                 | 0.00    | 1.00    | 0.60   | 0.49                              | 125   | 0.00    | 1.00    | 0.95   | 0.21           |
|                                | Teacher Years of Experience*** | 1,968                                 | 0.00    | 42.00   | 9.44   | 9.72                              | 125   | 4.00    | 37.00   | 14.24  | 7.15           |
|                                | English I                      | Number of students**                  | 1,119   | 1.00    | 178.00 | 49.45                             | 36.72 | 65      | 5.00    | 162.00 | 63.98          |
| Percent White***               |                                | 1,607                                 | 0.00    | 1.00    | 0.29   | 0.26                              | 113   | 0.00    | 0.93    | 0.51   | 0.28           |
| English I z-score***           |                                | 1,607                                 | -2.95   | 1.43    | -0.47  | 0.82                              | 113   | -1.66   | 1.34    | 0.20   | 0.76           |
| Percent LEP                    |                                | 1,607                                 | 0.00    | 1.00    | 0.15   | 0.29                              | 113   | 0.00    | 1.00    | 0.11   | 0.22           |
| Percent Gifted***              |                                | 1,607                                 | 0.00    | 0.67    | 0.08   | 0.12                              | 113   | 0.00    | 0.66    | 0.21   | 0.18           |
| Percent EC***                  |                                | 1,607                                 | 0.00    | 1.00    | 0.20   | 0.33                              | 113   | 0.00    | 1.00    | 0.08   | 0.20           |
| Percent Retained**             |                                | 1,604                                 | 0.00    | 1.00    | 0.12   | 0.19                              | 113   | 0.00    | 1.00    | 0.06   | 0.15           |
| School Percent White***        |                                | 1,450                                 | 0.00    | 0.83    | 0.32   | 0.24                              | 107   | 0.00    | 0.83    | 0.47   | 0.24           |
| School Percent LEP             |                                | 1,450                                 | 0.00    | 0.44    | 0.08   | 0.06                              | 107   | 0.00    | 0.28    | 0.07   | 0.06           |
| School Percent EC**            |                                | 1,450                                 | 0.00    | 1.00    | 0.11   | 0.12                              | 107   | 0.00    | 0.50    | 0.08   | 0.06           |
| School Percent Gifted***       | 1,450                          | 0.00                                  | 0.35    | 0.10    | 0.08   | 107                               | 0.00  | 0.32    | 0.15    | 0.09   |                |
| School English I z-score***    | 1,438                          | -2.22                                 | 0.77    | -0.10   | 0.44   | 106                               | -1.01 | 0.75    | 0.15    | 0.40   |                |
| Number of behavior incidents*  | 488                            | 0.00                                  | 15.00   | 1.46    | 1.72   | 48                                | 0.00  | 5.50    | 0.86    | 1.18   |                |
| Teacher Percent White***       | 1,593                          | 0.00                                  | 1.00    | 0.66    | 0.47   | 113                               | 0.00  | 1.00    | 0.85    | 0.36   |                |
| Teacher Years of Experience*** | 1,606                          | 0.00                                  | 38.00   | 8.86    | 9.42   | 113                               | 4.00  | 38.00   | 15.82   | 8.85   |                |



| Test Subject                   | Descriptive Variables         | Non-National Board Certified Teachers |         |         |        |                | National Board Certified Teachers |         |         |        |                |       |
|--------------------------------|-------------------------------|---------------------------------------|---------|---------|--------|----------------|-----------------------------------|---------|---------|--------|----------------|-------|
|                                |                               | N                                     | Minimum | Maximum | Mean   | Std. Deviation | N                                 | Minimum | Maximum | Mean   | Std. Deviation |       |
| Algebra II                     | Number of students            | 609                                   | 4.00    | 181.00  | 89.76  | 42.62          | 52                                | 16.00   | 155.00  | 80.88  | 31.57          |       |
|                                | Percent White                 | 609                                   | 0.00    | 0.96    | 0.48   | 0.27           | 52                                | 0.05    | 0.90    | 0.47   | 0.25           |       |
|                                | Algebra II z-score***         | 861                                   | -2.01   | 2.82    | -0.17  | 0.75           | 84                                | -0.99   | 1.70    | 0.39   | 0.69           |       |
|                                | Percent LEP                   | 609                                   | 0.00    | 0.35    | 0.04   | 0.05           | 52                                | 0.00    | 0.29    | 0.05   | 0.06           |       |
|                                | Percent Gifted*               | 609                                   | 0.00    | 0.90    | 0.17   | 0.16           | 52                                | 0.00    | 0.73    | 0.22   | 0.19           |       |
|                                | Percent EC                    | 609                                   | 0.00    | 1.00    | 0.05   | 0.13           | 52                                | 0.00    | 0.10    | 0.02   | 0.02           |       |
|                                | Percent Retained              | 609                                   | 0.00    | 0.78    | 0.06   | 0.09           | 52                                | 0.00    | 0.35    | 0.05   | 0.08           |       |
|                                | School Percent White          | 777                                   | 0.00    | 0.83    | 0.37   | 0.26           | 81                                | 0.00    | 0.82    | 0.36   | 0.22           |       |
|                                | School Percent LEP*           | 777                                   | 0.00    | 0.44    | 0.06   | 0.06           | 81                                | 0.00    | 0.20    | 0.08   | 0.05           |       |
|                                | School Percent EC             | 777                                   | 0.00    | 1.00    | 0.10   | 0.11           | 81                                | 0.00    | 0.35    | 0.08   | 0.04           |       |
|                                | School Percent Gifted         | 777                                   | 0.00    | 0.48    | 0.12   | 0.09           | 81                                | 0.00    | 0.28    | 0.11   | 0.07           |       |
|                                | School Algebra II z-score     | 644                                   | -1.57   | 2.53    | -0.10  | 0.59           | 75                                | -1.49   | 1.34    | -0.06  | 0.45           |       |
|                                | Number of behavior incidents* | 252                                   | 0.00    | 4.80    | 0.51   | 0.65           | 32                                | 0.00    | 1.23    | 0.35   | 0.32           |       |
|                                | Teacher Percent White**       | 854                                   | 0.00    | 1.00    | 0.74   | 0.44           | 84                                | 0.00    | 1.00    | 0.89   | 0.31           |       |
|                                | Teacher Years of Experience** | 861                                   | 0.00    | 41.00   | 13.20  | 11.49          | 84                                | 5.00    | 39.00   | 16.85  | 8.91           |       |
|                                | Biology                       | Number of students                    | 774     | 1.00    | 187.00 | 75.70          | 49.80                             | 90      | 1.00    | 175.00 | 85.47          | 45.63 |
|                                |                               | Percent White***                      | 774     | 0.00    | 1.00   | 0.37           | 0.27                              | 90      | 0.00    | 0.88   | 0.49           | 0.26  |
| Biology z-score***             |                               | 1,062                                 | -3.03   | 1.50    | -0.37  | 0.80           | 125                               | -2.50   | 1.64    | 0.07   | 0.73           |       |
| Percent LEP                    |                               | 774                                   | 0.00    | 1.00    | 0.07   | 0.16           | 90                                | 0.00    | 0.77    | 0.04   | 0.10           |       |
| Percent Gifted***              |                               | 774                                   | 0.00    | 0.71    | 0.11   | 0.14           | 90                                | 0.00    | 0.70    | 0.21   | 0.15           |       |
| Percent EC*                    |                               | 774                                   | 0.00    | 1.00    | 0.17   | 0.31           | 90                                | 0.00    | 1.00    | 0.10   | 0.25           |       |
| Percent Retained**             |                               | 774                                   | 0.00    | 1.00    | 0.13   | 0.15           | 90                                | 0.00    | 0.50    | 0.08   | 0.10           |       |
| School Percent White**         |                               | 949                                   | 0.00    | 0.83    | 0.33   | 0.25           | 121                               | 0.00    | 0.82    | 0.40   | 0.25           |       |
| School Percent LEP             |                               | 949                                   | 0.00    | 0.44    | 0.07   | 0.06           | 121                               | 0.00    | 0.25    | 0.06   | 0.05           |       |
| School Percent EC              |                               | 949                                   | 0.00    | 1.00    | 0.11   | 0.13           | 121                               | 0.00    | 0.50    | 0.10   | 0.06           |       |
| School Percent Gifted***       | 949                           | 0.00                                  | 0.35    | 0.10    | 0.08   | 121            | 0.00                              | 0.35    | 0.14    | 0.10   |                |       |
| School Biology z-score**       | 865                           | -2.24                                 | 1.37    | -0.08   | 0.52   | 117            | -1.08                             | 1.29    | 0.09    | 0.47   |                |       |
| Number of behavior incidents   | 288                           | 0.00                                  | 17.00   | 1.04    | 1.67   | 35             | 0.00                              | 2.79    | 0.55    | 0.70   |                |       |
| Teacher Percent White***       | 1,049                         | 0.00                                  | 1.00    | 0.64    | 0.48   | 125            | 0.00                              | 1.00    | 0.85    | 0.36   |                |       |
| Teacher Years of Experience*** | 1,062                         | 0.00                                  | 40.00   | 8.42    | 8.89   | 125            | 4.00                              | 35.00   | 14.57   | 8.16   |                |       |

| Test Subject                   | Descriptive Variables               | Non-National Board Certified Teachers |         |         |        |                |      | National Board Certified Teachers |         |        |                |  |  |
|--------------------------------|-------------------------------------|---------------------------------------|---------|---------|--------|----------------|------|-----------------------------------|---------|--------|----------------|--|--|
|                                |                                     | N                                     | Minimum | Maximum | Mean   | Std. Deviation | N    | Minimum                           | Maximum | Mean   | Std. Deviation |  |  |
| Civics and Economics           | Number of students                  | 103                                   | 1.00    | 186.00  | 78.48  | 55.11          | 7    | 25.00                             | 152.00  | 62.86  | 46.22          |  |  |
|                                | Percent White                       | 103                                   | 0.00    | 0.88    | 0.31   | 0.27           | 7    | 0.00                              | 0.78    | 0.23   | 0.28           |  |  |
|                                | Civics and Economics z-score        | 433                                   | -2.14   | 1.64    | -0.28  | 0.69           | 33   | -1.71                             | 1.62    | -0.05  | 0.73           |  |  |
|                                | Percent LEP*                        | 103                                   | 0.00    | 1.00    | 0.08   | 0.17           | 7    | 0.00                              | 1.00    | 0.23   | 0.38           |  |  |
|                                | Percent Gifted                      | 103                                   | 0.00    | 0.46    | 0.09   | 0.11           | 7    | 0.00                              | 0.51    | 0.10   | 0.19           |  |  |
|                                | Percent EC                          | 103                                   | 0.00    | 1.00    | 0.29   | 0.41           | 7    | 0.00                              | 0.13    | 0.05   | 0.05           |  |  |
|                                | Percent Retained                    | 103                                   | 0.00    | 0.61    | 0.13   | 0.13           | 7    | 0.00                              | 0.28    | 0.11   | 0.11           |  |  |
|                                | School Percent White                | 433                                   | 0.01    | 0.82    | 0.33   | 0.25           | 33   | 0.01                              | 0.81    | 0.26   | 0.24           |  |  |
|                                | School Percent LEP                  | 433                                   | 0.00    | 0.44    | 0.10   | 0.07           | 33   | 0.02                              | 0.28    | 0.09   | 0.06           |  |  |
|                                | School Percent EC                   | 433                                   | 0.00    | 1.00    | 0.09   | 0.08           | 33   | 0.04                              | 0.13    | 0.08   | 0.02           |  |  |
|                                | School Percent Gifted               | 433                                   | 0.00    | 0.30    | 0.10   | 0.07           | 33   | 0.00                              | 0.30    | 0.10   | 0.07           |  |  |
|                                | School Civics and Economics z-score | 430                                   | -1.50   | 0.96    | -0.08  | 0.42           | 33   | -1.00                             | 0.68    | -0.13  | 0.39           |  |  |
|                                | Number of behavior incidents        | 330                                   | 0.00    | 17.00   | 1.07   | 1.74           | 26   | 0.00                              | 4.00    | 0.85   | 0.96           |  |  |
|                                | Teacher Percent White**             | 433                                   | 0.00    | 1.00    | 0.76   | 0.43           | 33   | 0.00                              | 1.00    | 0.97   | 0.17           |  |  |
| Teacher Years of Experience*** | 433                                 | 0.00                                  | 37.00   | 8.46    | 8.65   | 33             | 5.00 | 30.00                             | 16.36   | 9.52   |                |  |  |
| Chemistry                      | Number of students                  | 357                                   | 3.00    | 173.00  | 106.65 | 40.06          | 58   | 6.00                              | 169.00  | 114.69 | 33.09          |  |  |
|                                | Percent White***                    | 357                                   | 0.00    | 0.95    | 0.50   | 0.27           | 58   | 0.43                              | 0.94    | 0.70   | 0.14           |  |  |
|                                | Chemistry z-score***                | 459                                   | -1.96   | 1.35    | -0.12  | 0.63           | 72   | -1.57                             | 1.66    | 0.25   | 0.61           |  |  |
|                                | Percent LEP***                      | 357                                   | 0.00    | 0.29    | 0.04   | 0.03           | 58   | 0.00                              | 0.10    | 0.02   | 0.02           |  |  |
|                                | Percent Gifted***                   | 357                                   | 0.00    | 0.70    | 0.20   | 0.15           | 58   | 0.00                              | 0.63    | 0.34   | 0.14           |  |  |
|                                | Percent EC                          | 357                                   | 0.00    | 1.00    | 0.02   | 0.06           | 58   | 0.00                              | 1.00    | 0.03   | 0.13           |  |  |
|                                | Percent Retained                    | 357                                   | 0.00    | 0.79    | 0.05   | 0.09           | 58   | 0.00                              | 0.50    | 0.03   | 0.07           |  |  |
|                                | School Percent White***             | 407                                   | 0.00    | 0.83    | 0.34   | 0.25           | 64   | 0.00                              | 0.83    | 0.55   | 0.20           |  |  |
|                                | School Percent LEP***               | 407                                   | 0.00    | 0.32    | 0.07   | 0.06           | 64   | 0.00                              | 0.13    | 0.04   | 0.03           |  |  |
|                                | School Percent EC                   | 407                                   | 0.00    | 1.00    | 0.10   | 0.10           | 64   | 0.00                              | 1.00    | 0.10   | 0.14           |  |  |
|                                | School Percent Gifted***            | 407                                   | 0.00    | 0.35    | 0.10   | 0.09           | 64   | 0.00                              | 0.35    | 0.18   | 0.09           |  |  |
|                                | School Chemistry z-score***         | 317                                   | -1.81   | 1.75    | -0.10  | 0.55           | 49   | -0.81                             | 1.75    | 0.23   | 0.45           |  |  |
|                                | Number of behavior incidents        | 102                                   | 0.00    | 6.50    | 0.42   | 0.84           | 14   | 0.00                              | 0.89    | 0.29   | 0.22           |  |  |
|                                | Teacher Percent White**             | 455                                   | 0.00    | 1.00    | 0.74   | 0.44           | 72   | 0.00                              | 1.00    | 0.90   | 0.30           |  |  |
| Teacher Years of Experience*** | 458                                 | 0.00                                  | 41.00   | 11.79   | 11.05  | 72             | 9.00 | 39.00                             | 22.42   | 8.88   |                |  |  |

| Test Subject                   | Descriptive Variables          | Non-National Board Certified Teachers |         |         |        |                | National Board Certified Teachers |         |         |        |                |       |
|--------------------------------|--------------------------------|---------------------------------------|---------|---------|--------|----------------|-----------------------------------|---------|---------|--------|----------------|-------|
|                                |                                | N                                     | Minimum | Maximum | Mean   | Std. Deviation | N                                 | Minimum | Maximum | Mean   | Std. Deviation |       |
| Geometry                       | Number of students***          | 840                                   | 3.00    | 189.00  | 86.31  | 41.25          | 56                                | 12.00   | 155.00  | 60.48  | 32.56          |       |
|                                | Percent White***               | 840                                   | 0.00    | 1.00    | 0.43   | 0.27           | 56                                | 0.00    | 0.94    | 0.58   | 0.27           |       |
|                                | Geometry z-score***            | 1,117                                 | -2.26   | 2.46    | 0.01   | 0.87           | 87                                | -1.33   | 2.07    | 0.66   | 0.82           |       |
|                                | Percent LEP*                   | 840                                   | 0.00    | 0.64    | 0.05   | 0.06           | 56                                | 0.00    | 0.11    | 0.03   | 0.03           |       |
|                                | Percent Gifted***              | 840                                   | 0.00    | 0.90    | 0.15   | 0.16           | 56                                | 0.00    | 1.00    | 0.31   | 0.27           |       |
|                                | Percent EC                     | 840                                   | 0.00    | 1.00    | 0.07   | 0.18           | 56                                | 0.00    | 0.22    | 0.03   | 0.04           |       |
|                                | Percent Retained               | 840                                   | 0.00    | 1.00    | 0.08   | 0.12           | 56                                | 0.00    | 0.43    | 0.05   | 0.10           |       |
|                                | School Percent White***        | 1,024                                 | 0.00    | 0.83    | 0.36   | 0.25           | 84                                | 0.00    | 0.83    | 0.49   | 0.26           |       |
|                                | School Percent LEP             | 1,024                                 | 0.00    | 0.44    | 0.07   | 0.06           | 84                                | 0.00    | 0.36    | 0.06   | 0.06           |       |
|                                | School Percent EC              | 1,024                                 | 0.00    | 1.00    | 0.10   | 0.10           | 84                                | 0.00    | 0.50    | 0.09   | 0.08           |       |
|                                | School Percent Gifted***       | 1,024                                 | 0.00    | 0.49    | 0.12   | 0.10           | 84                                | 0.00    | 0.64    | 0.19   | 0.15           |       |
|                                | School Geometry z-score***     | 905                                   | -3.26   | 2.21    | -0.14  | 0.90           | 79                                | -2.41   | 2.07    | 0.25   | 1.01           |       |
|                                | Number of behavior incidents*  | 277                                   | 0.00    | 5.33    | 0.54   | 0.75           | 31                                | 0.00    | 0.85    | 0.24   | 0.26           |       |
|                                | Teacher Percent White***       | 1,105                                 | 0.00    | 1.00    | 0.69   | 0.46           | 87                                | 0.00    | 1.00    | 0.95   | 0.21           |       |
|                                | Teacher Years of Experience*** | 1,114                                 | 0.00    | 41.00   | 11.25  | 10.53          | 87                                | 5.00    | 31.00   | 16.11  | 6.95           |       |
|                                | Physics                        | Number of students**                  | 146     | 5.00    | 168.00 | 79.21          | 41.85                             | 32      | 42.00   | 177.00 | 104.00         | 39.56 |
|                                |                                | Percent White***                      | 146     | 0.00    | 0.93   | 0.54           | 0.26                              | 32      | 0.61    | 0.92   | 0.77           | 0.09  |
| Physics z-score**              |                                | 196                                   | -1.94   | 1.44    | -0.21  | 0.70           | 39                                | -1.07   | 1.60    | 0.12   | 0.54           |       |
| Percent LEP                    |                                | 146                                   | 0.00    | 0.17    | 0.04   | 0.04           | 32                                | 0.00    | 0.08    | 0.03   | 0.02           |       |
| Percent Gifted**               |                                | 146                                   | 0.00    | 0.78    | 0.32   | 0.20           | 32                                | 0.06    | 0.81    | 0.42   | 0.16           |       |
| Percent EC                     |                                | 146                                   | 0.00    | 0.11    | 0.01   | 0.02           | 32                                | 0.00    | 0.05    | 0.01   | 0.01           |       |
| Percent Retained               |                                | 146                                   | 0.00    | 0.36    | 0.02   | 0.05           | 32                                | 0.00    | 0.10    | 0.01   | 0.02           |       |
| School Percent White***        |                                | 180                                   | 0.00    | 0.83    | 0.35   | 0.25           | 35                                | 0.00    | 0.83    | 0.53   | 0.21           |       |
| School Percent LEP             |                                | 180                                   | 0.00    | 0.28    | 0.07   | 0.06           | 35                                | 0.00    | 0.24    | 0.06   | 0.05           |       |
| School Percent EC              |                                | 180                                   | 0.00    | 1.00    | 0.10   | 0.11           | 35                                | 0.00    | 0.21    | 0.07   | 0.04           |       |
| School Percent Gifted***       | 180                            | 0.00                                  | 0.35    | 0.11    | 0.09   | 35             | 0.00                              | 0.35    | 0.17    | 0.09   |                |       |
| School Physics z-score         | 115                            | -1.94                                 | 1.15    | -0.21   | 0.62   | 22             | -1.30                             | 0.74    | 0.03    | 0.46   |                |       |
| Number of behavior incidents*  | 50                             | 0.00                                  | 0.67    | 0.17    | 0.18   | 7              | 0.00                              | 0.28    | 0.11    | 0.11   |                |       |
| Teacher Percent White**        | 195                            | 0.00                                  | 1.00    | 0.82    | 0.39   | 39             | 1.00                              | 1.00    | 1.00    | 0.00   |                |       |
| Teacher Years of Experience*** | 195                            | 0.00                                  | 37.00   | 11.06   | 9.87   | 39             | 6.00                              | 42.00   | 26.05   | 11.70  |                |       |

| Test Subject                   | Descriptive Variables           | Non-National Board Certified Teachers |         |         |        |                | National Board Certified Teachers |         |         |        |                |       |
|--------------------------------|---------------------------------|---------------------------------------|---------|---------|--------|----------------|-----------------------------------|---------|---------|--------|----------------|-------|
|                                |                                 | N                                     | Minimum | Maximum | Mean   | Std. Deviation | N                                 | Minimum | Maximum | Mean   | Std. Deviation |       |
| Physical Science               | Number of students              | 182                                   | 3.00    | 171.00  | 63.85  | 50.25          | 4                                 | 14.00   | 134.00  | 67.00  | 61.29          |       |
|                                | Percent White                   | 182                                   | 0.00    | 0.90    | 0.33   | 0.23           | 4                                 | 0.14    | 0.73    | 0.46   | 0.27           |       |
|                                | Physical Science z-score        | 281                                   | -2.47   | 1.61    | -0.38  | 0.70           | 11                                | -1.72   | 0.62    | -0.20  | 0.73           |       |
|                                | Percent LEP                     | 182                                   | 0.00    | 1.00    | 0.07   | 0.16           | 4                                 | 0.00    | 0.02    | 0.01   | 0.01           |       |
|                                | Percent Gifted                  | 182                                   | 0.00    | 0.41    | 0.06   | 0.09           | 4                                 | 0.00    | 0.21    | 0.11   | 0.12           |       |
|                                | Percent EC                      | 182                                   | 0.00    | 1.00    | 0.19   | 0.35           | 4                                 | 0.00    | 0.04    | 0.01   | 0.02           |       |
|                                | Percent Retained                | 181                                   | 0.00    | 0.79    | 0.16   | 0.15           | 4                                 | 0.00    | 0.20    | 0.09   | 0.08           |       |
|                                | School Percent White**          | 198                                   | 0.00    | 0.81    | 0.30   | 0.24           | 10                                | 0.00    | 0.75    | 0.51   | 0.25           |       |
|                                | School Percent LEP              | 198                                   | 0.00    | 0.28    | 0.07   | 0.07           | 10                                | 0.00    | 0.19    | 0.07   | 0.06           |       |
|                                | School Percent EC               | 198                                   | 0.00    | 1.00    | 0.13   | 0.16           | 10                                | 0.04    | 0.50    | 0.11   | 0.14           |       |
|                                | School Percent Gifted**         | 198                                   | 0.00    | 0.35    | 0.08   | 0.08           | 10                                | 0.00    | 0.29    | 0.16   | 0.09           |       |
|                                | School Physical Science z-score | 154                                   | -2.29   | 0.84    | -0.18  | 0.52           | 9                                 | -0.26   | 0.96    | 0.23   | 0.44           |       |
|                                | Number of behavior incidents*   | 99                                    | 0.00    | 7.00    | 1.54   | 1.47           | 7                                 | 0.10    | 1.16    | 0.76   | 0.43           |       |
|                                | Teacher Percent White           | 279                                   | 0.00    | 1.00    | 0.62   | 0.49           | 11                                | 0.00    | 1.00    | 0.91   | 0.30           |       |
|                                | Teacher Years of Experience***  | 281                                   | 0.00    | 33.00   | 8.59   | 8.55           | 11                                | 5.00    | 39.00   | 22.09  | 12.50          |       |
|                                | US History                      | Number of students*                   | 454     | 1.00    | 181.00 | 65.11          | 50.25                             | 28      | 5.00    | 152.00 | 87.93          | 49.53 |
|                                |                                 | Percent White**                       | 454     | 0.00    | 1.00   | 0.38           | 0.27                              | 28      | 0.08    | 0.88   | 0.54           | 0.28  |
| US History z-score***          |                                 | 705                                   | -2.98   | 1.58    | -0.47  | 0.83           | 71                                | -2.01   | 1.41    | 0.34   | 0.73           |       |
| Percent LEP                    |                                 | 454                                   | 0.00    | 1.00    | 0.08   | 0.19           | 28                                | 0.00    | 1.00    | 0.12   | 0.29           |       |
| Percent Gifted***              |                                 | 454                                   | 0.00    | 0.77    | 0.12   | 0.15           | 28                                | 0.00    | 0.72    | 0.28   | 0.19           |       |
| Percent EC                     |                                 | 454                                   | 0.00    | 1.00    | 0.11   | 0.28           | 28                                | 0.00    | 0.13    | 0.02   | 0.03           |       |
| Percent Retained**             |                                 | 454                                   | 0.00    | 1.00    | 0.12   | 0.14           | 28                                | 0.00    | 0.33    | 0.04   | 0.07           |       |
| School Percent White***        |                                 | 608                                   | 0.00    | 0.83    | 0.30   | 0.23           | 70                                | 0.00    | 0.83    | 0.45   | 0.25           |       |
| School Percent LEP             |                                 | 608                                   | 0.00    | 0.28    | 0.08   | 0.07           | 70                                | 0.00    | 0.28    | 0.08   | 0.06           |       |
| School Percent EC              |                                 | 608                                   | 0.00    | 1.00    | 0.11   | 0.12           | 70                                | 0.00    | 1.00    | 0.10   | 0.12           |       |
| School Percent Gifted***       | 608                             | 0.00                                  | 0.35    | 0.09    | 0.08   | 70             | 0.00                              | 0.30    | 0.14    | 0.08   |                |       |
| School US History z-score***   | 434                             | -1.57                                 | 1.48    | -0.12   | 0.55   | 62             | -0.55                             | 1.17    | 0.17    | 0.36   |                |       |
| Number of behavior incidents** | 251                             | 0.00                                  | 12.00   | 0.92    | 1.40   | 43             | 0.00                              | 0.90    | 0.30    | 0.25   |                |       |
| Teacher Percent White***       | 701                             | 0.00                                  | 1.00    | 0.75    | 0.43   | 71             | 0.00                              | 1.00    | 0.97    | 0.17   |                |       |
| Teacher Years of Experience*** | 705                             | 0.00                                  | 40.00   | 9.20    | 8.86   | 71             | 4.00                              | 31.00   | 13.83   | 6.71   |                |       |

| Test Subject                    | Descriptive Variables           | Non-National Board Certified Teachers |         |         |        |                | National Board Certified Teachers |         |         |        |                |       |
|---------------------------------|---------------------------------|---------------------------------------|---------|---------|--------|----------------|-----------------------------------|---------|---------|--------|----------------|-------|
|                                 |                                 | N                                     | Minimum | Maximum | Mean   | Std. Deviation | N                                 | Minimum | Maximum | Mean   | Std. Deviation |       |
| Math                            | Number of students              | 12,058                                | 2.00    | 192.00  | 48.93  | 19.84          | 682                               | 4.00    | 155.00  | 49.25  | 17.89          |       |
|                                 | Percent White***                | 12,058                                | 0.00    | 1.00    | 0.38   | 0.27           | 682                               | 0.00    | 1.00    | 0.52   | 0.29           |       |
|                                 | Math z-score***                 | 18,446                                | -3.94   | 2.16    | -0.20  | 0.66           | 1,430                             | -2.44   | 2.05    | 0.22   | 0.65           |       |
|                                 | Percent LEP**                   | 12,058                                | 0.00    | 1.00    | 0.07   | 0.09           | 682                               | 0.00    | 0.60    | 0.06   | 0.09           |       |
|                                 | Percent Gifted***               | 12,058                                | 0.00    | 1.00    | 0.12   | 0.16           | 682                               | 0.00    | 1.00    | 0.22   | 0.21           |       |
|                                 | Percent EC***                   | 12,058                                | 0.00    | 1.00    | 0.17   | 0.26           | 682                               | 0.00    | 1.00    | 0.12   | 0.18           |       |
|                                 | Percent Retained***             | 10,734                                | 0.00    | 1.00    | 0.02   | 0.04           | 674                               | 0.00    | 0.50    | 0.01   | 0.04           |       |
|                                 | School Percent White***         | 18,446                                | 0.00    | 0.94    | 0.36   | 0.26           | 1,430                             | 0.00    | 0.92    | 0.49   | 0.28           |       |
|                                 | School Percent LEP              | 18,446                                | 0.00    | 0.69    | 0.09   | 0.10           | 1,430                             | 0.00    | 0.69    | 0.09   | 0.10           |       |
|                                 | School Percent EC***            | 18,446                                | 0.00    | 1.00    | 0.10   | 0.05           | 1,430                             | 0.00    | 1.00    | 0.09   | 0.05           |       |
|                                 | School Percent Gifted***        | 18,446                                | 0.00    | 0.97    | 0.14   | 0.12           | 1,430                             | 0.00    | 0.97    | 0.21   | 0.14           |       |
|                                 | School Math z-score***          | 18,446                                | -1.65   | 1.36    | -0.06  | 0.44           | 1,430                             | -1.32   | 1.36    | 0.20   | 0.48           |       |
|                                 | Number of behavior incidents*** | 6,392                                 | -1.00   | 16.00   | 0.42   | 0.90           | 748                               | 0.00    | 9.86    | 0.23   | 0.59           |       |
|                                 | Teacher Percent White***        | 18,347                                | 0.00    | 1.00    | 0.70   | 0.46           | 1,429                             | 0.00    | 1.00    | 0.83   | 0.37           |       |
|                                 | Teacher Years of Experience***  | 18,432                                | 0.00    | 45.00   | 8.75   | 9.02           | 1,430                             | 4.00    | 39.00   | 13.70  | 7.52           |       |
|                                 | Read                            | Number of students                    | 12,486  | 1.00    | 168.00 | 46.42          | 19.03                             | 742     | 3.00    | 145.00 | 50.37          | 17.97 |
|                                 |                                 | Percent White***                      | 12,486  | 0.00    | 1.00   | 0.38           | 0.27                              | 742     | 0.00    | 1.00   | 0.53           | 0.29  |
| Read z-score***                 |                                 | 19,004                                | -3.22   | 1.90    | -0.18  | 0.68           | 1,513                             | -2.34   | 1.83    | 0.21   | 0.61           |       |
| Percent LEP**                   |                                 | 12,486                                | 0.00    | 1.00    | 0.07   | 0.11           | 742                               | 0.00    | 0.67    | 0.06   | 0.09           |       |
| Percent Gifted***               |                                 | 12,486                                | 0.00    | 1.00    | 0.13   | 0.16           | 742                               | 0.00    | 1.00    | 0.22   | 0.20           |       |
| Percent EC***                   |                                 | 12,486                                | 0.00    | 1.00    | 0.17   | 0.26           | 742                               | 0.00    | 1.00    | 0.11   | 0.16           |       |
| Percent Retained***             |                                 | 11,130                                | 0.00    | 1.00    | 0.02   | 0.05           | 732                               | 0.00    | 0.33    | 0.01   | 0.03           |       |
| School Percent White***         |                                 | 19,004                                | 0.00    | 0.94    | 0.36   | 0.27           | 1,513                             | 0.00    | 0.92    | 0.47   | 0.28           |       |
| School Percent LEP              |                                 | 19,004                                | 0.00    | 0.69    | 0.09   | 0.10           | 1,513                             | 0.00    | 0.69    | 0.09   | 0.10           |       |
| School Percent EC***            |                                 | 19,004                                | 0.00    | 1.00    | 0.10   | 0.05           | 1,513                             | 0.00    | 1.00    | 0.09   | 0.05           |       |
| School Percent Gifted***        | 19,004                          | 0.00                                  | 0.97    | 0.14    | 0.12   | 1,513          | 0.00                              | 0.97    | 0.20    | 0.14   |                |       |
| School Read z-score***          | 19,004                          | -2.33                                 | 1.14    | -0.06   | 0.43   | 1,513          | -1.52                             | 1.14    | 0.17    | 0.46   |                |       |
| Number of behavior incidents*** | 6,518                           | 0.00                                  | 15.75   | 0.42    | 0.91   | 771            | 0.00                              | 9.86    | 0.26    | 0.69   |                |       |
| Teacher Percent White***        | 18,918                          | 0.00                                  | 1.00    | 0.70    | 0.46   | 1,512          | 0.00                              | 1.00    | 0.81    | 0.39   |                |       |
| Teacher Years of Experience***  | 18,995                          | 0.00                                  | 45.00   | 8.75    | 9.01   | 1,513          | 4.00                              | 39.00   | 13.30   | 7.47   |                |       |

\*\*\* = differences between NBCTs and non-NBCTs are statistically significant at the  $p < .001$  level.\*\* = differences between NBCTs and non-NBCTs are statistically significant at the  $p < .01$  level.\* = differences between NBCTs and non-NBCTs are statistically significant at the  $p < .05$  level.

## Appendix B. Estimates of the effects of National Board certified EOC teachers using different model specifications.

|   | Algebra I          |                    |                    |                    |                    |                    |                    |                      |                    |                    |
|---|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|----------------------|--------------------|--------------------|
|   | Model 1            | Model 2            | Model 3            | Model 4            | Model 5            | Model 6†           | Model 7            | Model 8              | Model 9            | Model 10           |
| NBCT                                      | 0.0310<br>(0.0214) | 0.0355<br>(0.0211) | 0.0355<br>(0.0211) | 0.0332<br>(0.0211) | 0.0340<br>(0.0210) | 0.0324<br>(0.0205) | 0.0216<br>(0.0181) | 0.00228<br>(0.00844) | 0.0110<br>(0.0771) | 0.0181<br>(0.0189) |
| Teacher Experience Controls               | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes                  | yes                | yes                |
| Lag(1) Test Score                         | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes                  | yes                | no                 |
| Lag(2) Test Score                         | no                 | yes                | yes                | yes                | yes                | yes                | yes                | yes                  | yes                | no                 |
| Quadratic Functional Form on Lagged Tests | no                 | no                 | no                 | yes                | yes                | yes                | yes                | yes                  | yes                | no                 |
| Cubic Functional Form on Lagged Tests     | no                 | no                 | no                 | no                 | yes                | yes                | yes                | yes                  | yes                | no                 |
| Student Controls                          | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes                  | yes                | yes                |
| Class Controls                            | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes                  | yes                | yes                |
| School Controls                           | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes                  | yes                | yes                |
| Race Controls                             | no                 | no                 | no                 | no                 | no                 | yes                | yes                | yes                  | yes                | yes                |
| Ever vs. Never NBCT                       | no                 | no                 | no                 | no                 | no                 | no                 | yes                | yes                  | yes                | yes                |
| School Fixed Effects                      | no                 | no                 | no                 | no                 | no                 | no                 | no                 | yes                  | yes                | no                 |
| School-student Fixed Effects              | no                 | no                 | no                 | no                 | no                 | no                 | no                 | no                   | yes                | no                 |
| Gain scores                               | no                 | no                 | no                 | no                 | no                 | no                 | no                 | no                   | no                 | yes                |
| Observations                              | 53079              | 53079              | 53079              | 53079              | 53079              | 53079              | 53079              | 53079                | 53079              | 53079              |
| Adjusted R-squared                        | 0.648              | 0.677              | 0.677              | 0.679              | 0.680              | 0.682              | 0.682              | 0.695                | 0.846              | 0.070              |
| Total Unique Teacher-Years                | 1514               | 1514               | 1514               | 1514               | 1514               | 1514               | 1514               | 1514                 | 1514               | 1514               |
| Total Unique Number of Teachers           | 703                | 703                | 703                | 703                | 703                | 703                | 703                | 703                  | 703                | 703                |
| Total Unique NBCT Teachers                | 47                 | 47                 | 47                 | 47                 | 47                 | 47                 | 47                 | 47                   | 47                 | 47                 |
| Total Unique Non-NBCT Teachers            | 675                | 675                | 675                | 675                | 675                | 675                | 656                | 656                  | 656                | 656                |
| Total Students with NBCT Teachers         | 4211               | 4211               | 4211               | 4211               | 4211               | 4211               | 5632               | 5632                 | 5632               | 5632               |
| Total Students w/o NBCT Teachers          | 48868              | 48868              | 48868              | 48868              | 48868              | 48868              | 47447              | 47447                | 47447              | 47447              |
| Minimum Year in Sample                    | 2001               | 2001               | 2001               | 2001               | 2001               | 2001               | 2001               | 2001                 | 2001               | 2001               |
| Maximum Year in Sample                    | 2009               | 2009               | 2009               | 2009               | 2009               | 2009               | 2009               | 2009                 | 2009               | 2009               |
| Grades in Sample                          | 8-12               | 8-12               | 8-12               | 8-12               | 8-12               | 8-12               | 8-12               | 8-12                 | 8-12               | 8-12               |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

|   | English I          |                    |                    |                    |                    |                    |                    |               |                   |                    |
|---|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|--------------------|---------------|-------------------|--------------------|
|   | Model 1            | Model 2            | Model 3            | Model 4            | Model 5            | Model 6†           | Model 7            | Model 8       | Model 9           | Model 10           |
| NBCT                                      | 0.0139<br>(0.0181) | 0.0124<br>(0.0174) | 0.0124<br>(0.0174) | 0.0106<br>(0.0170) | 0.0114<br>(0.0170) | 0.0164<br>(0.0169) | 0.0247<br>(0.0149) | 0.0114<br>( ) | 0.0882<br>(0.134) | 0.0221<br>(0.0158) |
| Teacher Experience Controls               | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes           | yes               | yes                |
| Lag(1) Test Score                         | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes           | yes               | no                 |
| Lag(2) Test Score                         | no                 | yes                | yes                | yes                | yes                | yes                | yes                | yes           | yes               | no                 |
| Quadratic Functional Form on Lagged Tests | no                 | no                 | no                 | yes                | yes                | yes                | yes                | yes           | yes               | no                 |
| Cubic Functional Form on Lagged Tests     | no                 | no                 | no                 | no                 | yes                | yes                | yes                | yes           | yes               | no                 |
| Student Controls                          | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes           | yes               | yes                |
| Class Controls                            | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes           | yes               | yes                |
| School Controls                           | yes                | yes                | yes                | yes                | yes                | yes                | yes                | yes           | yes               | yes                |
| Race Controls                             | no                 | no                 | no                 | no                 | no                 | yes                | yes                | yes           | yes               | yes                |
| Ever vs. Never NBCT                       | no                 | no                 | no                 | no                 | no                 | no                 | yes                | yes           | yes               | yes                |
| School Fixed Effects                      | no                 | no                 | no                 | no                 | no                 | no                 | no                 | yes           | yes               | no                 |
| School-student Fixed Effects              | no                 | no                 | no                 | no                 | no                 | no                 | no                 | no            | yes               | no                 |
| Gain scores                               | no                 | no                 | no                 | no                 | no                 | no                 | no                 | no            | no                | yes                |
| Observations                              | 61562              | 61562              | 61562              | 61562              | 61562              | 61562              | 61562              | 61562         | 61562             | 61562              |
| Adjusted R-squared                        | 0.676              | 0.709              | 0.709              | 0.711              | 0.713              | 0.714              | 0.714              | 0.716         | 0.844             | 0.049              |
| Total Unique Teacher-Years                | 1315               | 1315               | 1315               | 1315               | 1315               | 1315               | 1315               | 1315          | 1315              | 1315               |
| Total Unique Number of Teachers           | 530                | 530                | 530                | 530                | 530                | 530                | 530                | 530           | 530               | 530                |
| Total Unique NBCT Teachers                | 34                 | 34                 | 34                 | 34                 | 34                 | 34                 | 34                 | 34            | 34                | 34                 |
| Total Unique Non-NBCT Teachers            | 506                | 506                | 506                | 506                | 506                | 506                | 496                | 496           | 496               | 496                |
| Total Students with NBCT Teachers         | 5685               | 5685               | 5685               | 5685               | 5685               | 5685               | 7222               | 7222          | 7222              | 7222               |
| Total Students w/o NBCT Teachers          | 55877              | 55877              | 55877              | 55877              | 55877              | 55877              | 54340              | 54340         | 54340             | 54340              |
| Minimum Year in Sample                    | 2001               | 2001               | 2001               | 2001               | 2001               | 2001               | 2001               | 2001          | 2001              | 2001               |
| Maximum Year in Sample                    | 2009               | 2009               | 2009               | 2009               | 2009               | 2009               | 2009               | 2009          | 2009              | 2009               |
| Grades in Sample                          | 9-12               | 9-12               | 9-12               | 9-12               | 9-12               | 9-12               | 9-12               | 9-12          | 9-12              | 9-12               |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

|   | Algebra II            |                       |                       |                       |                       |                       |                       |                        |                   |                      |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|-------------------|----------------------|
|   | Model 1               | Model 2               | Model 3               | Model 4               | Model 5               | Model 6†              | Model 7               | Model 8                | Model 9           | Model 10             |
| NBCT                                      | 0.0853***<br>(0.0222) | 0.0767***<br>(0.0202) | 0.0767***<br>(0.0202) | 0.0791***<br>(0.0201) | 0.0775***<br>(0.0200) | 0.0881***<br>(0.0190) | 0.0946***<br>(0.0162) | 0.0769***<br>(0.00877) | 0.0728<br>(0.127) | 0.102***<br>(0.0179) |
| Teacher Experience Controls               | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | yes                  |
| Lag(1) Test Score                         | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | no                   |
| Lag(2) Test Score                         | no                    | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | no                   |
| Quadratic Functional Form on Lagged Tests | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | no                   |
| Cubic Functional Form on Lagged Tests     | no                    | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes                    | yes               | no                   |
| Student Controls                          | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | yes                  |
| Class Controls                            | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | yes                  |
| School Controls                           | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes               | yes                  |
| Race Controls                             | no                    | no                    | no                    | no                    | no                    | yes                   | yes                   | yes                    | yes               | yes                  |
| Ever vs. Never NBCT                       | no                    | no                    | no                    | no                    | no                    | no                    | yes                   | yes                    | yes               | yes                  |
| School Fixed Effects                      | no                    | no                    | no                    | no                    | no                    | no                    | no                    | yes                    | yes               | no                   |
| School-student Fixed Effects              | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                     | yes               | no                   |
| Gain scores                               | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                     | no                | yes                  |
| Observations                              | 39817                 | 39817                 | 39817                 | 39817                 | 39817                 | 39817                 | 39817                 | 39817                  | 39817             | 39817                |
| Adjusted R-squared                        | 0.642                 | 0.687                 | 0.687                 | 0.689                 | 0.692                 | 0.694                 | 0.695                 | 0.701                  | 0.810             | 0.078                |
| Total Unique Teacher-Years                | 667                   | 667                   | 667                   | 667                   | 667                   | 667                   | 667                   | 667                    | 667               | 667                  |
| Total Unique Number of Teachers           | 309                   | 309                   | 309                   | 309                   | 309                   | 309                   | 309                   | 309                    | 309               | 309                  |
| Total Unique NBCT Teachers                | 29                    | 29                    | 29                    | 29                    | 29                    | 29                    | 29                    | 29                     | 29                | 29                   |
| Total Unique Non-NBCT Teachers            | 291                   | 291                   | 291                   | 291                   | 291                   | 291                   | 280                   | 280                    | 280               | 280                  |
| Total Students with NBCT Teachers         | 4751                  | 4751                  | 4751                  | 4751                  | 4751                  | 4751                  | 6637                  | 6637                   | 6637              | 6637                 |
| Total Students w/o NBCT Teachers          | 35066                 | 35066                 | 35066                 | 35066                 | 35066                 | 35066                 | 33180                 | 33180                  | 33180             | 33180                |
| Minimum Year in Sample                    | 2003                  | 2003                  | 2003                  | 2003                  | 2003                  | 2003                  | 2003                  | 2003                   | 2003              | 2003                 |
| Maximum Year in Sample                    | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                   | 2009              | 2009                 |
| Grades in Sample                          | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                   | 8-12              | 8-12                 |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

|   | Biology               |                       |                       |                       |                       |                       |                       |                        |                     |                       |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|------------------------|---------------------|-----------------------|
|   | Model 1               | Model 2               | Model 3               | Model 4               | Model 5               | Model 6†              | Model 7               | Model 8                | Model 9             | Model 10              |
| NBCT                                      | 0.0892***<br>(0.0179) | 0.0892***<br>(0.0174) | 0.0892***<br>(0.0174) | 0.0916***<br>(0.0171) | 0.0917***<br>(0.0172) | 0.0986***<br>(0.0175) | 0.0789***<br>(0.0156) | 0.0755***<br>(0.00776) | -0.0398<br>(0.0976) | 0.0721***<br>(0.0164) |
| Teacher Experience Controls               | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | yes                   |
| Lag(1) Test Score                         | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | no                    |
| Lag(2) Test Score                         | no                    | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | no                    |
| Quadratic Functional Form on Lagged Tests | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | no                    |
| Cubic Functional Form on Lagged Tests     | no                    | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes                    | yes                 | no                    |
| Student Controls                          | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | yes                   |
| Class Controls                            | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | yes                   |
| School Controls                           | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                    | yes                 | yes                   |
| Race Controls                             | no                    | no                    | no                    | no                    | no                    | yes                   | yes                   | yes                    | yes                 | yes                   |
| Ever vs. Never NBCT                       | no                    | no                    | no                    | no                    | no                    | no                    | yes                   | yes                    | yes                 | yes                   |
| School Fixed Effects                      | no                    | no                    | no                    | no                    | no                    | no                    | no                    | yes                    | yes                 | no                    |
| School-student Fixed Effects              | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                     | yes                 | no                    |
| Gain scores                               | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                     | no                  | yes                   |
| Observations                              | 49924                 | 49924                 | 49924                 | 49924                 | 49924                 | 49924                 | 49924                 | 49924                  | 49924               | 49924                 |
| Adjusted R-squared                        | 0.604                 | 0.656                 | 0.656                 | 0.659                 | 0.661                 | 0.664                 | 0.663                 | 0.669                  | 0.783               | 0.059                 |
| Total Unique Teacher-Years                | 847                   | 847                   | 847                   | 847                   | 847                   | 847                   | 847                   | 847                    | 847                 | 847                   |
| Total Unique Number of Teachers           | 324                   | 324                   | 324                   | 324                   | 324                   | 324                   | 324                   | 324                    | 324                 | 324                   |
| Total Unique NBCT Teachers                | 30                    | 30                    | 30                    | 30                    | 30                    | 30                    | 30                    | 30                     | 30                  | 30                    |
| Total Unique Non-NBCT Teachers            | 304                   | 304                   | 304                   | 304                   | 304                   | 304                   | 294                   | 294                    | 294                 | 294                   |
| Total Students with NBCT Teachers         | 6174                  | 6174                  | 6174                  | 6174                  | 6174                  | 6174                  | 8101                  | 8101                   | 8101                | 8101                  |
| Total Students w/o NBCT Teachers          | 43750                 | 43750                 | 43750                 | 43750                 | 43750                 | 43750                 | 41823                 | 41823                  | 41823               | 41823                 |
| Minimum Year in Sample                    | 2002                  | 2002                  | 2002                  | 2002                  | 2002                  | 2002                  | 2002                  | 2002                   | 2002                | 2002                  |
| Maximum Year in Sample                    | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                   | 2009                | 2009                  |
| Grades in Sample                          | 9-12                  | 9-12                  | 9-12                  | 9-12                  | 9-12                  | 9-12                  | 9-12                  | 9-12                   | 9-12                | 9-12                  |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

|   | Civics and Economics |                      |                      |                      |                      |                     |                       |                      |                   |                       |
|---|----------------------|----------------------|----------------------|----------------------|----------------------|---------------------|-----------------------|----------------------|-------------------|-----------------------|
|   | Model 1              | Model 2              | Model 3              | Model 4              | Model 5              | Model 6†            | Model 7               | Model 8              | Model 9           | Model 10              |
| NBCT                                      | 0.0793**<br>(0.0304) | 0.0863**<br>(0.0309) | 0.0863**<br>(0.0309) | 0.0851**<br>(0.0313) | 0.0875**<br>(0.0311) | 0.0746*<br>(0.0307) | 0.0967***<br>(0.0269) | 0.131***<br>(0.0128) | 0.0777<br>(0.178) | 0.0967***<br>(0.0278) |
| Teacher Experience Controls               | yes                  | yes                  | yes                  | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | yes                   |
| Lag(1) Test Score                         | yes                  | yes                  | yes                  | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | no                    |
| Lag(2) Test Score                         | no                   | yes                  | yes                  | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | no                    |
| Quadratic Functional Form on Lagged Tests | no                   | no                   | no                   | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | no                    |
| Cubic Functional Form on Lagged Tests     | no                   | no                   | no                   | no                   | yes                  | yes                 | yes                   | yes                  | yes               | no                    |
| Student Controls                          | yes                  | yes                  | yes                  | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | yes                   |
| Class Controls                            | yes                  | yes                  | yes                  | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | yes                   |
| School Controls                           | yes                  | yes                  | yes                  | yes                  | yes                  | yes                 | yes                   | yes                  | yes               | yes                   |
| Race Controls                             | no                   | no                   | no                   | no                   | no                   | yes                 | yes                   | yes                  | yes               | yes                   |
| Ever vs. Never NBCT                       | no                   | no                   | no                   | no                   | no                   | no                  | yes                   | yes                  | yes               | yes                   |
| School Fixed Effects                      | no                   | no                   | no                   | no                   | no                   | no                  | no                    | yes                  | yes               | no                    |
| School-student Fixed Effects              | no                   | no                   | no                   | no                   | no                   | no                  | no                    | no                   | yes               | no                    |
| Gain scores                               | no                   | no                   | no                   | no                   | no                   | no                  | no                    | no                   | no                | yes                   |
| Observations                              | 30423                | 30423                | 30423                | 30423                | 30423                | 30423               | 30423                 | 30423                | 30423             | 30423                 |
| Adjusted R-squared                        | 0.642                | 0.687                | 0.687                | 0.689                | 0.693                | 0.695               | 0.695                 | 0.704                | 0.838             | 0.107                 |
| Total Unique Teacher-Years                | 424                  | 424                  | 424                  | 424                  | 424                  | 424                 | 424                   | 424                  | 424               | 424                   |
| Total Unique Number of Teachers           | 201                  | 201                  | 201                  | 201                  | 201                  | 201                 | 201                   | 201                  | 201               | 201                   |
| Total Unique NBCT Teachers                | 14                   | 14                   | 14                   | 14                   | 14                   | 14                  | 14                    | 14                   | 14                | 14                    |
| Total Unique Non-NBCT Teachers            | 190                  | 190                  | 190                  | 190                  | 190                  | 190                 | 187                   | 187                  | 187               | 187                   |
| Total Students with NBCT Teachers         | 1842                 | 1842                 | 1842                 | 1842                 | 1842                 | 1842                | 2509                  | 2509                 | 2509              | 2509                  |
| Total Students w/o NBCT Teachers          | 28581                | 28581                | 28581                | 28581                | 28581                | 28581               | 27914                 | 27914                | 27914             | 27914                 |
| Minimum Year in Sample                    | 2006                 | 2006                 | 2006                 | 2006                 | 2006                 | 2006                | 2006                  | 2006                 | 2006              | 2006                  |
| Maximum Year in Sample                    | 2009                 | 2009                 | 2009                 | 2009                 | 2009                 | 2009                | 2009                  | 2009                 | 2009              | 2009                  |
| Grades in Sample                          | 9-12                 | 9-12                 | 9-12                 | 9-12                 | 9-12                 | 9-12                | 9-12                  | 9-12                 | 9-12              | 9-12                  |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

|   | Chemistry           |                    |                    |                      |                     |                      |                      |                      |                  |                      |
|---|---------------------|--------------------|--------------------|----------------------|---------------------|----------------------|----------------------|----------------------|------------------|----------------------|
|   | Model 1             | Model 2            | Model 3            | Model 4              | Model 5             | Model 6†             | Model 7              | Model 8              | Model 9          | Model 10             |
| NBCT                                      | 0.104**<br>(0.0401) | 0.101*<br>(0.0394) | 0.101*<br>(0.0394) | 0.0976**<br>(0.0372) | 0.100**<br>(0.0376) | 0.0977**<br>(0.0318) | 0.130***<br>(0.0285) | 0.144***<br>(0.0139) | 0.131<br>(0.593) | 0.134***<br>(0.0315) |
| Teacher Experience Controls               | yes                 | yes                | yes                | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | yes                  |
| Lag(1) Test Score                         | yes                 | yes                | yes                | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | no                   |
| Lag(2) Test Score                         | no                  | yes                | yes                | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | no                   |
| Quadratic Functional Form on Lagged Tests | no                  | no                 | no                 | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | no                   |
| Cubic Functional Form on Lagged Tests     | no                  | no                 | no                 | no                   | yes                 | yes                  | yes                  | yes                  | yes              | no                   |
| Student Controls                          | yes                 | yes                | yes                | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | yes                  |
| Class Controls                            | yes                 | yes                | yes                | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | yes                  |
| School Controls                           | yes                 | yes                | yes                | yes                  | yes                 | yes                  | yes                  | yes                  | yes              | yes                  |
| Race Controls                             | no                  | no                 | no                 | no                   | no                  | yes                  | yes                  | yes                  | yes              | yes                  |
| Ever vs. Never NBCT                       | no                  | no                 | no                 | no                   | no                  | no                   | yes                  | yes                  | yes              | yes                  |
| School Fixed Effects                      | no                  | no                 | no                 | no                   | no                  | no                   | no                   | yes                  | yes              | no                   |
| School-student Fixed Effects              | no                  | no                 | no                 | no                   | no                  | no                   | no                   | no                   | yes              | no                   |
| Gain scores                               | no                  | no                 | no                 | no                   | no                  | no                   | no                   | no                   | no               | yes                  |
| Observations                              | 26234               | 26234              | 26234              | 26234                | 26234               | 26234                | 26234                | 26234                | 26234            | 26234                |
| Adjusted R-squared                        | 0.571               | 0.622              | 0.622              | 0.634                | 0.636               | 0.644                | 0.645                | 0.656                | 0.748            | 0.110                |
| Total Unique Teacher-Years                | 358                 | 358                | 358                | 358                  | 358                 | 358                  | 358                  | 358                  | 358              | 358                  |
| Total Unique Number of Teachers           | 154                 | 154                | 154                | 154                  | 154                 | 154                  | 154                  | 154                  | 154              | 154                  |
| Total Unique NBCT Teachers                | 17                  | 17                 | 17                 | 17                   | 17                  | 17                   | 17                   | 17                   | 17               | 17                   |
| Total Unique Non-NBCT Teachers            | 141                 | 141                | 141                | 141                  | 141                 | 141                  | 137                  | 137                  | 137              | 137                  |
| Total Students with NBCT Teachers         | 3847                | 3847               | 3847               | 3847                 | 3847                | 3847                 | 4586                 | 4586                 | 4586             | 4586                 |
| Total Students w/o NBCT Teachers          | 22387               | 22387              | 22387              | 22387                | 22387               | 22387                | 21648                | 21648                | 21648            | 21648                |
| Minimum Year in Sample                    | 2003                | 2003               | 2003               | 2003                 | 2003                | 2003                 | 2003                 | 2003                 | 2003             | 2003                 |
| Maximum Year in Sample                    | 2009                | 2009               | 2009               | 2009                 | 2009                | 2009                 | 2009                 | 2009                 | 2009             | 2009                 |
| Grades in Sample                          | 9-12                | 9-12               | 9-12               | 9-12                 | 9-12                | 9-12                 | 9-12                 | 9-12                 | 9-12             | 9-12                 |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.



|   | Geometry              |                       |                       |                       |                       |                       |                       |                       |                   |                       |
|---|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-------------------|-----------------------|
|   | Model 1               | Model 2               | Model 3               | Model 4               | Model 5               | Model 6†              | Model 7               | Model 8               | Model 9           | Model 10              |
| NBCT                                      | 0.0911***<br>(0.0251) | 0.0898***<br>(0.0209) | 0.0898***<br>(0.0209) | 0.0891***<br>(0.0205) | 0.0900***<br>(0.0204) | 0.0942***<br>(0.0207) | 0.0867***<br>(0.0183) | 0.0863***<br>(0.0101) | 0.0306<br>(0.113) | 0.0931***<br>(0.0214) |
| Teacher Experience Controls               | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | yes                   |
| Lag(1) Test Score                         | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | no                    |
| Lag(2) Test Score                         | no                    | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | no                    |
| Quadratic Functional Form on Lagged Tests | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | no                    |
| Cubic Functional Form on Lagged Tests     | no                    | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes                   | yes               | no                    |
| Student Controls                          | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | yes                   |
| Class Controls                            | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | yes                   |
| School Controls                           | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes                   | yes               | yes                   |
| Race Controls                             | no                    | no                    | no                    | no                    | no                    | yes                   | yes                   | yes                   | yes               | yes                   |
| Ever vs. Never NBCT                       | no                    | no                    | no                    | no                    | no                    | no                    | yes                   | yes                   | yes               | yes                   |
| School Fixed Effects                      | no                    | no                    | no                    | no                    | no                    | no                    | no                    | yes                   | yes               | no                    |
| School-student Fixed Effects              | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                    | yes               | no                    |
| Gain scores                               | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                    | no                | yes                   |
| Observations                              | 48019                 | 48019                 | 48019                 | 48019                 | 48019                 | 48019                 | 48019                 | 48019                 | 48019             | 48019                 |
| Adjusted R-squared                        | 0.691                 | 0.740                 | 0.740                 | 0.742                 | 0.744                 | 0.747                 | 0.747                 | 0.752                 | 0.839             | 0.085                 |
| Total Unique Teacher-Years                | 920                   | 920                   | 920                   | 920                   | 920                   | 920                   | 920                   | 920                   | 920               | 920                   |
| Total Unique Number of Teachers           | 402                   | 402                   | 402                   | 402                   | 402                   | 402                   | 402                   | 402                   | 402               | 402                   |
| Total Unique NBCT Teachers                | 31                    | 31                    | 31                    | 31                    | 31                    | 31                    | 31                    | 31                    | 31                | 31                    |
| Total Unique Non-NBCT Teachers            | 381                   | 381                   | 381                   | 381                   | 381                   | 381                   | 371                   | 371                   | 371               | 371                   |
| Total Students with NBCT Teachers         | 3008                  | 3008                  | 3008                  | 3008                  | 3008                  | 3008                  | 4122                  | 4122                  | 4122              | 4122                  |
| Total Students w/o NBCT Teachers          | 45011                 | 45011                 | 45011                 | 45011                 | 45011                 | 45011                 | 43897                 | 43897                 | 43897             | 43897                 |
| Minimum Year in Sample                    | 2001                  | 2001                  | 2001                  | 2001                  | 2001                  | 2001                  | 2001                  | 2001                  | 2001              | 2001                  |
| Maximum Year in Sample                    | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009                  | 2009              | 2009                  |
| Grades in Sample                          | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12                  | 8-12              | 8-12                  |

†Results of this model are reported in the body of this report.

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

†Results of this model are reported in the body of this report.

|   | Physics             |                     |                     |                     |                     |                    |                     |                      |                   |                     |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|--------------------|---------------------|----------------------|-------------------|---------------------|
|   | Model 1             | Model 2             | Model 3             | Model 4             | Model 5             | Model 6            | Model 7             | Model 8              | Model 9           | Model 10            |
| NBCT                                      | -0.0478<br>(0.0561) | -0.0414<br>(0.0518) | -0.0414<br>(0.0518) | -0.0405<br>(0.0522) | -0.0233<br>(0.0515) | 0.0132<br>(0.0526) | -0.0378<br>(0.0503) | -0.102**<br>(0.0372) | -0.263<br>(0.933) | -0.0832<br>(0.0553) |
| Teacher Experience Controls               | yes                 | yes                 | yes                 | yes                 | yes                 | yes                | yes                 | yes                  | yes               | yes                 |
| Lag(1) Test Score                         | yes                 | yes                 | yes                 | yes                 | yes                 | yes                | yes                 | yes                  | yes               | no                  |
| Lag(2) Test Score                         | no                  | yes                 | yes                 | yes                 | yes                 | yes                | yes                 | yes                  | yes               | no                  |
| Quadratic Functional Form on Lagged Tests | no                  | no                  | no                  | yes                 | yes                 | yes                | yes                 | yes                  | yes               | no                  |
| Cubic Functional Form on Lagged Tests     | no                  | no                  | no                  | no                  | yes                 | yes                | yes                 | yes                  | yes               | no                  |
| Student Controls                          | yes                 | yes                 | yes                 | yes                 | yes                 | yes                | yes                 | yes                  | yes               | yes                 |
| Class Controls                            | yes                 | yes                 | yes                 | yes                 | yes                 | yes                | yes                 | yes                  | yes               | yes                 |
| School Controls                           | yes                 | yes                 | yes                 | yes                 | yes                 | yes                | yes                 | yes                  | yes               | yes                 |
| Race Controls                             | no                  | no                  | no                  | no                  | no                  | yes                | yes                 | yes                  | yes               | yes                 |
| Ever vs. Never NBCT                       | no                  | no                  | no                  | no                  | no                  | no                 | yes                 | yes                  | yes               | yes                 |
| School Fixed Effects                      | no                  | no                  | no                  | no                  | no                  | no                 | no                  | yes                  | yes               | no                  |
| School-student Fixed Effects              | no                  | no                  | no                  | no                  | no                  | no                 | no                  | no                   | yes               | no                  |
| Gain scores                               | no                  | no                  | no                  | no                  | no                  | no                 | no                  | no                   | no                | yes                 |
| Observations                              | 6274                | 6274                | 6274                | 6274                | 6274                | 6274               | 6274                | 6274                 | 6274              | 6274                |
| Adjusted R-squared                        | 0.658               | 0.696               | 0.696               | 0.701               | 0.707               | 0.718              | 0.718               | 0.728                | 0.971             | 0.196               |
| Total Unique Teacher-Years                | 123                 | 123                 | 123                 | 123                 | 123                 | 123                | 123                 | 123                  | 123               | 123                 |
| Total Unique Number of Teachers           | 65                  | 65                  | 65                  | 65                  | 65                  | 65                 | 65                  | 65                   | 65                | 65                  |
| Total Unique NBCT Teachers                | 8                   | 8                   | 8                   | 8                   | 8                   | 8                  | 8                   | 8                    | 8                 | 8                   |
| Total Unique Non-NBCT Teachers            | 60                  | 60                  | 60                  | 60                  | 60                  | 60                 | 57                  | 57                   | 57                | 57                  |
| Total Students with NBCT Teachers         | 1598                | 1598                | 1598                | 1598                | 1598                | 1598               | 1923                | 1923                 | 1923              | 1923                |
| Total Students w/o NBCT Teachers          | 4676                | 4676                | 4676                | 4676                | 4676                | 4676               | 4351                | 4351                 | 4351              | 4351                |
| Minimum Year in Sample                    | 2003                | 2003                | 2003                | 2003                | 2003                | 2003               | 2003                | 2003                 | 2003              | 2003                |
| Maximum Year in Sample                    | 2009                | 2009                | 2009                | 2009                | 2009                | 2009               | 2009                | 2009                 | 2009              | 2009                |
| Grades in Sample                          | 9-12                | 9-12                | 9-12                | 9-12                | 9-12                | 9-12               | 9-12                | 9-12                 | 9-12              | 9-12                |

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\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.

†Results of this model are reported in the body of this report.

|   | Physical Science    |                     |                     |                     |                     |                     |                     |                     |                  |                     |
|---|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|---------------------|------------------|---------------------|
|   | Model 1             | Model 2             | Model 3             | Model 4             | Model 5             | Model 6†            | Model 7             | Model 8             | Model 9          | Model 10            |
| NBCT                                      | -0.0814<br>(0.0708) | -0.0898<br>(0.0662) | -0.0898<br>(0.0662) | -0.0847<br>(0.0658) | -0.0877<br>(0.0642) | -0.0545<br>(0.0620) | -0.0545<br>(0.0620) | -0.0819<br>(0.0617) | 0.112<br>(1.270) | -0.0547<br>(0.0719) |
| Teacher Experience Controls               | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | yes                 |
| Lag(1) Test Score                         | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | no                  |
| Lag(2) Test Score                         | no                  | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | no                  |
| Quadratic Functional Form on Lagged Tests | no                  | no                  | no                  | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | no                  |
| Cubic Functional Form on Lagged Tests     | no                  | no                  | no                  | no                  | yes                 | yes                 | yes                 | yes                 | yes              | no                  |
| Student Controls                          | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | yes                 |
| Class Controls                            | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | yes                 |
| School Controls                           | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes                 | yes              | yes                 |
| Race Controls                             | no                  | no                  | no                  | no                  | no                  | yes                 | yes                 | yes                 | yes              | yes                 |
| Ever vs. Never NBCT                       | no                  | no                  | no                  | no                  | no                  | no                  | yes                 | yes                 | yes              | yes                 |
| School Fixed Effects                      | no                  | no                  | no                  | no                  | no                  | no                  | no                  | yes                 | yes              | no                  |
| School-student Fixed Effects              | no                  | no                  | no                  | no                  | no                  | no                  | no                  | no                  | yes              | no                  |
| Gain scores                               | no                  | no                  | no                  | no                  | no                  | no                  | no                  | no                  | no               | yes                 |
| Observations                              | 6022                | 6022                | 6022                | 6022                | 6022                | 6022                | 6022                | 6022                | 6022             | 6022                |
| Adjusted R-squared                        | 0.452               | 0.479               | 0.479               | 0.480               | 0.488               | 0.501               | 0.501               | 0.516               | 0.757            | 0.142               |
| Total Unique Teacher-Years                | 124                 | 124                 | 124                 | 124                 | 124                 | 124                 | 124                 | 124                 | 124              | 124                 |
| Total Unique Number of Teachers           | 99                  | 99                  | 99                  | 99                  | 99                  | 99                  | 99                  | 99                  | 99               | 99                  |
| Total Unique NBCT Teachers                | 5                   | 5                   | 5                   | 5                   | 5                   | 5                   | 5                   | 5                   | 5                | 5                   |
| Total Unique Non-NBCT Teachers            | 94                  | 94                  | 94                  | 94                  | 94                  | 94                  | 94                  | 94                  | 94               | 94                  |
| Total Students with NBCT Teachers         | 449                 | 449                 | 449                 | 449                 | 449                 | 449                 | 449                 | 449                 | 449              | 449                 |
| Total Students w/o NBCT Teachers          | 5573                | 5573                | 5573                | 5573                | 5573                | 5573                | 5573                | 5573                | 5573             | 5573                |
| Minimum Year in Sample                    | 2002                | 2002                | 2002                | 2002                | 2002                | 2002                | 2002                | 2002                | 2002             | 2002                |
| Maximum Year in Sample                    | 2009                | 2009                | 2009                | 2009                | 2009                | 2009                | 2009                | 2009                | 2009             | 2009                |
| Grades in Sample                          | 9-12                | 9-12                | 9-12                | 9-12                | 9-12                | 9-12                | 9-12                | 9-12                | 9-12             | 9-12                |

\*\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .001$  level.

\*\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .01$  level.

\* = differences between NBCTs and non-NBCTs were statistically significant at the  $p < .05$  level.



*An Evaluation Report Prepared by the*  
**CENTER FOR RESEARCH & EVALUATION**  
**OFFICE OF ACCOUNTABILITY**

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