

# **The Impact of College Course Offerings on the Supply of Academically Talented Public School Teachers**

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This paper identifies the impact of undergraduate teacher certification programs on the likelihood that recent college graduates enter and remain in public school teaching jobs. More selective postsecondary institutions are far less likely to offer teacher certification programs and those that do offer them are less likely to allow students to complete them within their four undergraduate years. The effect of heterogeneous entry costs on the likelihood that college graduates enter public school teaching jobs has not been previously examined. Either college course offerings simply meet students' pre-existing interest in teaching careers, or the presence of teacher certification programs has a direct effect on undergraduates' career choices. First, to examine the overall relationship between the availability of teacher certification programs and the likelihood that academically talented students enter teaching careers, I combine Barron's ratings of college selectivity, detailed data tracking college seniors into the workforce, data on the types of teacher certification programs offered by their colleges, and data on states' certification requirements. Next, to isolate the causal effect of program offerings, I treat the selection issue related to students sorting into colleges based on pre-existing interest in teaching careers as an omitted variable problem. Using another data set that surveys high school seniors' career interests and tracks them into college, I estimate an upper bound for the magnitude of the bias in the baseline coefficient estimates. The results suggest that the addition of teacher certification programs that may be completed within four undergraduate years could increase rates of entry into public school teaching by at least 50% among recent graduates of certain selective colleges.

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## 1. Introduction

Given the immediate need for more teachers and the widespread desire to improve student achievement, there is increasing concern over how to put high-quality teachers in public school classrooms. What makes a good teacher? Certainly personal qualities and useful training experience contribute to a teacher's effectiveness. Just as we would not want to discourage compassionate individuals from teaching, we would not want to discourage academically talented individuals from teaching. However, it is possible that the current system does precisely this. State policies and college<sup>1</sup> course offerings put academically talented students at a relative disadvantage. More prestigious colleges are less likely to offer programs so that students can quickly and easily obtain teacher certification. Thus, these college students have less exposure to pathways to teaching and face higher costs of pursuing certification. They are also far less likely to enter public school teaching after graduating from college. Either college course offerings simply meet students' pre-existing demand to pursue teaching careers, or the presence of undergraduate teacher certification programs has a direct effect on individuals' career choices. If the former is true, then differential access to teacher certification programs has no effect on the supply of teachers. If the latter is true, then barriers to entry may be just as important as salary comparisons in explaining why more high-achieving individuals do not enter public school teaching jobs.

This paper investigates whether college course offerings do in fact have a causal effect on the likelihood that graduates of selective colleges enter public school teaching. First, to examine the overall relationship between college course offerings and the likelihood that academically talented students enter teaching careers, I combine Barron's (1998) ratings of college selectivity, detailed data tracking college seniors into the workforce, data on the types of teaching certification offered by their colleges, and data on states' certification requirements. Next, to isolate the causal effect of college course offerings, I address the selection issue related to students sorting into colleges based on their pre-existing interest in teaching. Treating this selection issue as an omitted variable problem and using a secondary data set to

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<sup>1</sup> Throughout this paper, I will use the term "colleges" to describe colleges and universities that offer Bachelor's degrees.

estimate various parameters, I find lower bound point estimates for the causal effect of college course offerings on entry into public school teaching.

The results suggest that the addition of undergraduate teacher certification programs at *some* elite colleges would lead to an increased presence of academically talented teachers in public school classrooms. In particular, these programs cause greater rates of entry for individuals who attend colleges rated in the “Highly Competitive” group. This is Barron’s second highest rating group, consisting of eighty-five colleges that produce approximately 11% of U.S. college graduates. The evidence suggests that converting post-B.A. or fifth-year teacher certification programs to programs that may also be completed within one’s four undergraduate years could, on average, increase the rate of entry into public school teaching by at least 50% at colleges such as Emory University, the University of California (at Berkeley or Davis or Los Angeles or Santa Barbara), and Whitman College.

## **2. Related Literature**

Despite frequent pleas to raise teacher salaries and/or to create new teacher induction programs, there is mixed evidence as to what actions would actually improve the quality of public school teachers.

While the debate over the effects of raising teacher salaries remains wide open,<sup>2</sup> the literature has generally ignored another factor that may possibly have an important effect on who enters teaching.

There may be considerable costs associated with entering public school teaching, as individuals may have to give up a year’s work, or at least part of a year’s work, in order to obtain teacher certification.

Furthermore, the costs of entering teaching are often inversely related to the quality of an individual’s

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<sup>2</sup> Recent studies (e.g. Figlio, 1997; Loeb & Page, 2000) find evidence that “high quality” teachers tend to go to higher paying districts. However, it is unclear whether raising teacher salaries, either generally or categorically, would entice more people with desirable characteristics to enter the teaching force. In fact, one study theorizes that raising teacher salaries may lead to lower teacher quality (Ballou & Podgursky, 1995). Other studies examine the effect of teacher salaries on the likelihood of teachers changing school districts or exiting the teaching profession (Hanushek, Kain, & Rivkin, 1999; Imazeki, 2001). These studies find that higher salaries tend to reduce both types of attrition, though the magnitude of the effect is not always large and varies by the type of district.

college. The more selective a college, the less likely it is to offer programs in which students may obtain teaching certifications within their four undergraduate years.

Previous research on entry into the public school teaching profession shows that graduates who earn higher test scores or who attend more selective colleges are less likely to become teachers. Hanushek & Pace (1995), using the High School and Beyond data for the high school class of 1980, report that college graduates who completed undergraduate teacher preparation programs had lower test scores than other college graduates. Ballou (1996), using the Survey of Recent College Graduates: 1976-1991, finds that graduates of highly selective colleges are less likely to (1) get certified, (2) apply for teaching jobs once certified, and even slightly less likely to (3) gain employment when applying for teaching jobs. If the third finding is a true phenomenon, then one would be concerned that increasing the fraction of academically talented graduates who pursue teaching careers would not necessarily lead to more of them actually teaching in public schools. However, the data used in my study, which allow one to more effectively differentiate between the decisions of employers and prospective teachers, do not support this finding.<sup>3</sup> On the other hand, the data are certainly consistent with Ballou's finding of lower rates of entry into teaching among graduates from relatively selective colleges. The purpose of the empirical section below is to determine the extent to which these trends are due to the causal effect of limited undergraduate certification programs at relatively selective colleges.

Since this paper examines how pathways towards teacher certification affect whether individuals from selective colleges become teachers, it is worth reviewing what the school production function literature reveals about the influence that teachers' undergraduate training and cognitive abilities have on their students' achievement. The school production function literature has produced mixed results

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<sup>3</sup> Based on the Baccalaureate & Beyond (B&B) data, graduates from colleges rated in Barron's top three selectivity groups who are fully certified to teach are slightly more likely to teach than other fully certified graduates (87.6% versus 86.5%). Fully certified applicants for teaching jobs from these more selective colleges are also more likely to receive at least one job offer (92.7% versus 89.1%). Controlling for the number of jobs that they apply to, applicants who graduated from more selective colleges receive more job offers. These findings may differ from Ballou's (1997) findings, because the latter used a proxy for an individual failing to receive teaching job offers.

concerning which inputs are systematically effective in raising student achievement.<sup>4</sup> One problem with estimating the returns to various inputs is that there is endogenous sorting of students into schools with various traits. There is rarely a valid instrument for the presence of an input, and even studies that examine net gains in student achievement over time cannot fully control for the relationship between sorting and unobserved variables related to student academic growth. Another problem is the strong collinearity of the inputs themselves, causing a high likelihood of serious omitted variable bias. This latter issue is particularly problematic when one hopes to find the causal relationship between teacher characteristics and student achievement. For example, individuals from highly selective colleges who pursue teaching careers might tend to have lower alternative wages than their college classmates. These individuals may thus have unobserved characteristics that are not only negatively correlated with alternative wages, but are also negatively correlated with productivity as a teacher. Ehrenberg and Brewer (1994) find that the selectivity of a teacher's undergraduate college is significantly, positively related to teachers' students' test score gains, but that this result depends on the other independent variables used in the regression and on the race of the students. Studies (Ferguson, 1991; Ehrenberg & Brewer, 1995; Coleman et. al, 1966) generally find a positive correlation between students' performance and their teachers' scores on tests that measure the teachers' verbal abilities. As for overall teacher quality, Hanushek, Kain, & Rivkin (1998) estimate that variation in teacher quality within Texas public schools accounts for at least 7.5% of the variation in student achievement and probably much more.<sup>5</sup> In summary, while the relative importance of teacher characteristics is open to debate, the school production function literature is consistent with the logical ideas that teacher quality plays an important role in student achievement and that a teacher's academic abilities contribute to his or her overall quality.

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<sup>4</sup> Hanushek (1986; 1997) and Greenwald, Hedges & Lane (1994) offer various interpretations of the school spending literature. See Monk & Rice (1999) for an excellent summary of findings concerning the productivity of specific types of inputs.

<sup>5</sup> The authors find this conservative lower bound by assuming that none of the between-school variation in student test score growth is related to differences in teacher quality.

### **3. Framework: College Students' Potential Pathways to Public School Teaching Jobs**

Before discussing the descriptive and quantitative analyses, it may be helpful to discuss individuals' progression towards public school teaching or other careers. All states require public school teachers to have earned a Bachelor's degree, as well as some type of certification at the elementary or secondary level.<sup>6</sup>

This paper focuses on the impact of undergraduate teacher certification programs that may be completed within four undergraduate years. For the remainder of the paper, I will refer to these programs as UTCP's. If one attends a college without a UTCP, or if one chooses not to enroll in such a program, then he or she may still obtain certification. This person could attend a post-B.A. certification program at his or her undergraduate institution or at another college. These programs are typically one year long, and students must cover the full tuition, including paying for the opportunity to serve as a student teacher in a K-12 classroom. In some states, there are other, "alternative" pathways towards certification. Individuals can sometimes obtain emergency certification, which allows them to take classes towards full certification and simultaneously teach in a public school district that has traditionally had shortages of qualified, certified teachers. Teach for America is a program that specifically targets undergraduates at selective colleges who are interested in teaching and matches them with school districts that need to hire emergency certified teachers. Aside from emergency certification, some colleges or school districts offer formal, alternative certification programs that allow for non-traditional or accelerated training. Teachers with emergency or alternative certification still face entry costs, because they are required to engage in part-time training towards full certification.

One would expect graduates from colleges offering UTCP's to be more likely to ultimately become public school teachers. High school students who are already interested in teaching careers may prefer to enroll in these colleges. In addition to this sorting effect, individuals may have dynamic preferences, so that the presence of a UTCP could have a causal effect on the likelihood that individuals

become teachers. Many high school seniors are unsure of their career goals when entering college. Some others may base their college enrollment decision on factors unrelated to the college's course offerings, such as tuition, prestige, or location. For example, individuals initially interested in teaching may choose to enroll in a college that does not offer a UTCP, with the intentions of pursuing regular or alternative certification after their four undergraduate years. While individuals attend college, availability of a UTCP could increase the likelihood that they pursue teaching careers. There are two reasons why a UTCP could increase the likelihood that an individual becomes interested in teaching or the likelihood that an individual with a pre-existing interest in teaching remains interested. First, since individuals may complete UTCP's within their four undergraduate years, they can avoid the tuition and opportunity cost associated with pursuing teacher certification after graduation. Second, the mere presence of UTCP's might lead to more information about teaching and thus build greater levels of interest.

Many other factors will influence the likelihood that an individual becomes a teacher. Family characteristics, individual characteristics, and one's pre-existing interest in teaching will influence progress towards a teaching career as an individual decides which college to attend, which courses to take, whether to pursue teacher certification, and whether to pursue a public school teaching job. These decisions will also be influenced by expected teacher salary and working conditions, as compared to one's potential alternative income.<sup>7</sup> In addition, various state policies will affect the relative desirability of pursuing teaching or of pursuing a certain type of certification. To the extent that certification is non-transferable across states, location preferences could influence whether an individual pursues certification as an undergraduate. For example, if an undergraduate believes that there is a high probability that he or she will later move to a state that does not readily accept certification from the

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<sup>6</sup> Elementary certification typically allows one to teach in Kindergarten through sixth grade, while secondary certification allows one to teach in high school. Most states require secondary certification for public middle school teachers, though some use elementary certification or allow certification that is specific to middle school instruction.

<sup>7</sup> Since teaching jobs here refer to teaching jobs in public schools, jobs at private schools are included in the range of alternative jobs. However, some of the empirical analysis will also examine what factors influence entry into any

state of the undergraduate's college, then this individual may not want to bother pursuing certification as an undergraduate. In actuality, most states have official reciprocity agreements with other states agreeing to fully recognize teacher certification from the other state.<sup>8</sup>

Some factors may also influence the marginal effect of the presence of a UTCP on the likelihood that one becomes a teacher. The interaction most relevant to this paper's analysis is the relationship between the selectivity of an individual's college and the marginal effect of a UTCP. The expected direction of this relationship is actually ambiguous. On the one hand, graduates from very selective colleges will generally have relatively high opportunity costs associated with pursuing certification after college graduation. One might thus expect the marginal effect of a UTCP to be greater at these colleges. On the other hand, there may be few students at these colleges who are sufficiently close to the margin so that the presence of a UTCP actually could affect their decision. Since their alternative salary is so much greater than their potential salary as a teacher, students at an extremely selective college may only decide to become teachers when this decision is dominated by non-pecuniary factors. Given the ambiguous relationship between college selectivity and the marginal effect of the presence of a UTCP, it will be important to identify which types of colleges are associated with the largest effects.

#### **4. Data**

The focus of this paper is on the entry of recent college graduates from selective colleges into public school teaching jobs. In order to conduct the main analysis, I use restricted-use data from the National Center for Education Statistics' Baccalaureate & Beyond (B&B) that tracks college Seniors into the workforce. The B&B data is an excellent source of information on entry into teaching, since the

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type of teaching job. This allows one to determine the extent to which the unavailability of undergraduate certification programs causes a shift towards private teaching jobs rather than non-teaching jobs.

<sup>8</sup> Currently, forty states and the District of Columbia have official reciprocity agreements with other states, with each state typically agreeing to recognize teacher certification from more than thirty other states (NASDTEC..., 2000). The majority of the states without official reciprocity agreements grant provisional or full certification if the



survey was designed partly with this topic in mind. This includes data on whether individuals receiving Bachelor's degrees in 1993 later enter various stages of the "teacher pipeline," a useful construct to describe progress towards becoming a teacher. The "teacher pipeline" stages include (1) whether the student trains or applies to teach, (2) whether the student teaches by 1997, and (3) whether someone who has taught indicates that teaching is in their long term plans.

I combine the B&B data with existing data on state certification policies and with newly gathered data on college course offerings. The college course offering information was collected through email messages, phone calls, analysis of websites, and analysis of information in a published report (NASDTEC..., 2000). For each college, at least two independent sources were consulted. For both elementary and secondary certification, the college course offering information includes: (1) whether the college offers the certification program at all, (2) whether the college offers the certification program so that undergraduates may complete it within their regular timeframe towards the B.A. (roughly 4 years), and (3) whether the college offers combined certification/Master's degree programs. Question (2) is based on whether some students are *able* to receive certification within their four undergraduate years, without spending any extra semesters, summer semesters, or other extra time pursuing this certification. These college course offering measures generally pertain to 2000, rather than the time period of the B&B. Unobserved changes in college course offerings over this time are thus a potential source of measurement error.

The college certification program data are available for all colleges in Barron's (1998) top three selectivity rating groups. Analysis of the B&B data suggests that these groups individually composed 4.3%, 11.3%, and 26.7% (from most to third-most selective) of the total fraction of young, recent graduates from non-military colleges. In order to isolate recent college graduates who might be interested in teaching careers, I restrict the sample to students attending nonmilitary colleges who enter college before the age of 22 and graduate from college before the age of 30.

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outside state's requirements meet certain standards or if the individual completed a teacher preparation program at an institution certified by the NCATE (National Council for the Accreditation of Teacher Education).

In addition to these data sources, I use IPEDS (Integrated Post-secondary Education Data System) data to further characterize one's undergraduate institution and use NELS (National Education Longitudinal Survey) data to characterize progress towards teaching that occurs prior to college enrollment. For all analyses, I use the appropriate sample weights given by the NELS or B&B. Using these weights, one may find nationally representative estimates for both the total student population and students attending various types of colleges.

## **5. Descriptive Analysis**

With the framework of Section 3 in mind, this section answers some descriptive questions about entry into teaching. Though this analysis is not useful for describing causal effects or predicting the impact of policy changes, it provides background information about who enters public school teaching jobs.

### *5.1 What fraction of recent college graduates who become teachers come from institutions with various college selectivity ratings?*

A breakdown of recent college graduates entering teaching is presented in Table 1. Though graduates from more selective colleges are less likely to enter teaching, undergraduates at these schools are also more likely to graduate than undergraduates at less selective colleges. Thus, the proportion of new, young teachers coming from highly selective colleges is similar to the proportion of undergraduates enrolled at these colleges. This implies that changes in the fraction of graduates from highly selective schools who enter teaching could have a nontrivial impact on the overall distribution of teachers.

### *5.2 What fraction of colleges offer various types of teacher certification programs?*

Table 2 displays the breakdown of certification offerings by the percentage of undergraduates enrolled at schools offering the various types of programs within the top three college selectivity

ratings.<sup>9</sup> One can readily observe that the more selective colleges are less likely to offer all types of certification programs. The most striking percentages are the relatively low fraction of students at Highly Competitive institutions who have access to any elementary certification program and the relatively high fraction of students at Very Competitive institutions who may earn elementary or secondary certification within their four undergraduate years.

*5.3 Sorted by the type of certification offerings at their postsecondary institution, what fraction of students enter various stages of the “teacher pipeline”?*

Figure 1 displays the fraction of students, sorted by college selectivity rating, reaching various stages of the teacher pipeline. The stages are intended to measure levels of interest in a long-term public school teaching career. The first stage, labeled “1989,” uses the NELS data set to measure interest in teaching careers among high school seniors. The rates are based on the types of postsecondary institutions actually attended in 1990 by students in the high school class of 1988, sorted by whether they indicated a future interest in teaching in 1988. I defined students as interested in teaching careers if they either chose “School Teacher” as their anticipated choice of occupation at age 30 or they chose “Education” as their most likely major in college.<sup>10</sup> An individual graduating college four years after finishing high school in the B&B sample would have been in the high school class of 1989, which is why this point is labeled 1989 even though it is based on information from the high school class of 1988 in the NELS.

The next three points in the teacher pipeline represented in Figure 1 are based on the B&B sample. The 1994 point indicates whether the student, one year after receiving a B.A., reports a long-term interest in teaching when asked directly about this. The 1997 point indicates whether the student has taught in a public school before or during 1997. The sector (public or private) of employment for

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<sup>9</sup> The B&B data are representative of these population frequencies. Using the composition of college graduates in the B&B data, one estimates similar rates of exposure to certification programs within each college selectivity rating group.

<sup>10</sup> Not all Education majors entail earning a teacher certification program, though the most common types of majors focus on elementary education and do entail receiving elementary certification. One certainly need not major in

some individuals who became teachers is missing; these individuals are counted as teaching in a public school if they have any type of certification (including emergency), a necessary but not a sufficient condition for teaching in a public school rather than private school. The final point in the pipeline is labeled 2000, though this is actually based on a forward-looking survey question asked in 1997. This point reveals whether individuals who reached the previous point (teaching in a public school by 1997) indicate that they plan to remain teaching or working in schools beyond 1999. Individuals indicating plans to move to non-teaching jobs in schools are included, so that movement into jobs such as school counselor or principal is not discounted. As one would suspect, the more selective one's college, the less likely one is to indicate a long-term interest in public school teaching at any stage.

Figure 2 displays the fraction of individuals reaching these same stages, but sorted by whether their college offered either type of four-year undergraduate teacher certification program. These relationships will be the main focus of the quantitative analysis below. The qualitative differences in these figures are similar to the effects that one observes from the probit estimates described in the next section. The second selectivity group, Highly Competitive, has the least amount of initial sorting (difference between the two percentages in 1989) and the largest differences in long-term teaching outcomes (differences in 1997 and 2000). There are compelling reasons why the second rating group has less sorting than the first (Most Competitive) or third (Very Competitive) rating groups. There is likely less sorting in the second rating group than in the third rating group, because students choose colleges based on many other factors and it would be more difficult to gain admission to colleges in the second rating group that both meet these criteria and also offer undergraduate teacher training programs. There is likely less sorting in the second rating group than in the first rating group, because the second group contains far more students attending public schools than does the first rating group (see Table 3). Students who need or want to attend a public college within their own state may be less able to factor teacher certification offerings into their enrollment decision. The next section will describe the

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Education to enter an undergraduate teacher program. Many states require public secondary school teachers to major or minor in the field that they teach, and some forbid them to major in Education.

quantitative analysis used to isolate the direct relationship between certification offerings and various teaching outcomes.

## **6. Quantitative Analysis and Results**

The goal of this analysis is to exploit cross-sectional variation in college teacher certification offerings in order to estimate the impact of a college adding a UTCP (four-year undergraduate teacher certification program). In particular, one would like to know how the addition of a UTCP at colleges that currently only offer post-B.A. or fifth-year certification programs would affect the rates by which graduates from this college enter and remain in public school teaching jobs. Probit estimates examining teacher supply can be used to make these general equilibrium predictions only if two conditions are met: (1) availability of UTCP's is not endogenous with respect to the supply and demand for teachers from these rating groups, and (2) the impact of adding a UTCP does not have other general equilibrium effects that reduce supply. I will discuss the second issue in the next section, and address the first issue of potential endogeneity here.

### *6.1 Exogeneity of Colleges' Teacher Certification Offerings*

If the availability of UTCP's at colleges is based on the net demand for teachers, then cross-sectional estimates will not measure the causal effect of these programs, even when one accounts for the sorting that occurs when individuals select their colleges. For example, states in dire need of teachers might pressure private colleges or mandate public colleges to offer these programs. Another possibility is that states with strong teachers unions influence colleges to not offer these programs, so that the demand for existing teachers remains high and higher salaries and benefits are required.

One way around this issue is that a version of each of the models below will include state fixed effects. State dummy variables will control for all of the endogenous variables affecting the net supply of teachers, such as the relative size of the K-12 population, teacher salaries relative to others, teachers' working conditions and benefits, and the various state requirements for obtaining teacher certification.

Although data describing these factors are available, they are so numerous that the number of controls would approach the number of states in the sample, implying that state fixed effects are appropriate.

Even without the inclusion of state fixed effects, one need not worry about the endogeneity of UTCP availability as much as one might suspect. On the surface, the availability of UTCP's does not appear to be related to the net supply of teachers.<sup>11</sup> In California, where urban areas traditionally have massive shortages of certified teachers, the public University of California campuses are prohibited from offering these UTCP's. No such program exists at the University of California at Los Angeles, while the L.A. Unified School District has had to create a program by which it hires and internally trains hundreds of uncertified teachers each year. In private colleges, the availability of UTCP's and other certification programs appears to be more closely linked to the perceived prestige of producing graduates from these programs than to the actual market need for teachers. An example of the possible importance of occupational prestige is the fact that the most selective colleges are much more likely to offer secondary certification programs than elementary certification programs (see Table 2). This may result from societal views that very intelligent people are wasting their talents when teaching in elementary schools. Similarly, many of these elite colleges may want their graduates to leave college with a wide breath of knowledge and with detailed mastery of a non-Education major. The extra time devoted to train teachers, especially the extra time devoted to the craft of teaching in elementary schools, may be thus viewed as replacing more important instructional time. Finally, the lack of UTCP's at an elite college may be a remnant of the time when this college was an exclusively male institution and teachers in the K-12 education system were predominantly female. Whether a college was all-male in 1950 is negatively related to whether it currently offers a UTCP.<sup>12</sup> Overall, the

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<sup>11</sup> Although UTCP offerings generally seem to be exogenous with respect to the net supply of teachers, these offerings appear to be endogenous with respect to state policies or labor market conditions that affect the relative return of enrollment in different types of certification programs. For example, availability of UTCP's is negatively correlated with the state's average salary premium associated with first-year public school teachers possessing a Master's degree. This reinforces the importance of including geographic dummy variables.

<sup>12</sup> When a dummy variable for whether a college currently offers a UTCP is regressed on variables concerning various institutional characteristics, the coefficient on a dummy variable for whether the college was all-male in

availability of UTCP's does not appear to be strongly related to the net supply of teachers. Appendix 1 displays examples of colleges that do or do not have these programs, and the breakdown appears fairly arbitrary.

## 6.2 Empirical Methods

The focus of the empirics here will be on the impact of shortening existing certification programs so that a college offers either an elementary or secondary four-year UTCP. Ideally, one would also be able to estimate the impact of a college adding some type of teacher certification program when one was not previously offered. However, there are simply not enough individuals attending colleges that do not offer any certification programs, (only about 3% of the sample), for this to be identified based on cross-sectional analyses. In order to isolate the effect of shortening programs rather than adding them, these recent graduates from colleges without any certification programs are dropped from the sample. The key independent variable of interest for the baseline regression is whether the college offers *either* type of four-year program. Though data is available on the grade level chosen by some teachers, there are too many missing values concerning grade level for one to separately measure the effects of elementary certification programs on elementary teaching and secondary programs on secondary teaching.

In order to isolate the impact of the presence of at least one UTCP on entry into teaching, one must include various controls for the factors described in Section 3. Although enrolling in a college with certain characteristics may only be mildly related to whether one wants to teach, it is important to include various institutional control variables, because they may be correlated with whether the college offers a UTCP. Institutional controls include dummy variables for whether the college is public, religiously affiliated, offers a Ph.D. in any subject, and for the college's selectivity rating group. The other institutional controls are cubic terms for the college's total undergraduate enrollment. Individual controls include scores on SAT or ACT tests. These variables are important because they are indicators

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1950 is negative, though not statistically significant at the .10 level. The marginal effect, estimated at the mean

of ability to gain admission to colleges, potential academic success in college, and earning potential after graduation. Dummy variables that interact race with gender are also included, as these may be related to one's interest in teaching. Characteristics of an individual's parents may also influence the individual's interest in teaching and his or her academic success. Though parental income is unavailable, measures of parental education and country of birth are included. Estimates of population means and standard deviations, calculated using sample probability weights, for all of these independent variables are displayed in Table 3. To account for the net demand for teachers, including endogenous factors such as salaries and requirements, various models add state or regional dummies.

Let  $P_{ij}$  be a dummy variable concerning whether individual  $i$  graduating from college  $j$  becomes a teacher. Define  $X_{1i}$  as a vector of individual and parental control variables,  $X_{2j}$  as a vector of institutional control variables,  $X_{3i}^*$  as a variable measuring individual  $i$ 's interest in a teaching career before enrolling in college,  $X_{4j}$  as a dummy variable for whether the college offers an undergraduate teaching program, and  $D_j$  as a vector of regional or state dummy variables for the location of the college. The "true" discrete choice model for individual  $i$  graduating from college  $j$  would thus be:

$$P_{ij}^* = \beta_0 + X_{1i}\beta_1 + X_{2j}\beta_2 + \beta_3 X_{3i}^* + \beta_4 X_{4j} + D_j\beta_5 + \epsilon_{ij} \quad (1)$$

$$P_{ij}=1 \text{ if } P_{ij}^* \geq 0, \quad P_{ij}=0 \text{ if } P_{ij}^* < 0 \quad (2)$$

Since the primary data set begins in individuals' senior year of college, one may not actually observe  $X_{3i}^*$  or any discrete version of this variable. The actual probit model that I estimate to find the baseline relationships is:

$$P_{ij}^* = \theta_0 + X_{1i}\theta_1 + X_{2j}\theta_2 + \theta_4 X_{4j} + D_j\theta_5 + e_{ij} \quad (3)$$

$$P_{ij}=1 \text{ if } P_{ij}^* \geq 0, \quad P_{ij}=0 \text{ if } P_{ij}^* < 0$$

Following the work of Yatchew & Griliches (1985), I derive an expression for the magnitude of the bias from omitting  $X_{3i}^*$ . Assume that  $X_{3i}^*$  and the other independent variables are related by a linear regression function:

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values, suggests that a college that was exclusively male in 1950 is 10% less likely to offer a UTCP.



$$X_{3i}^* = \gamma_0 + X_{1i}\gamma_1 + X_{2i}\gamma_2 + \gamma_4 X_{4i} + D_j\gamma_5 + u_{ij} \quad (4)$$

with  $E[u_{ij} | X_{3i}^*] = 0$  and  $\text{Var}(u_{ij}) = \sigma_u^2 = 1$ .

Substituting the right hand side of equation (4) into the  $X_{3i}^*$  term in equation (1), I re-write equation (1)

as:

$$P_{ij}^* = \beta_0 + \beta_3\gamma_0 + X_{1i}(\beta_1 + \beta_3\gamma_1) + X_{2i}(\beta_2 + \beta_3\gamma_2) + (\beta_4 + \beta_3\gamma_4)X_{4i} + D_j(\beta_5 + \beta_3\gamma_5) + \beta_3 u_{ij} + \varepsilon_{ij} \quad (1')$$

If  $X_{3i}^*$  is normally distributed conditional on the other independent variables, then (1') and (2) form a valid probit model with the residual having a mean of zero and a variance of  $\beta_3^2\sigma_u^2 + \sigma_\varepsilon^2$ , where  $\sigma_u^2$  and  $\sigma_\varepsilon^2$  are the variances of  $u_{ij}$  and  $\varepsilon_{ij}$  respectively. This suggests that consistent estimators of  $\theta_4$  will converge to

$$\frac{\beta_4 + \beta_3\gamma_4}{\sqrt{\beta_3^2\sigma_u^2 + \sigma_\varepsilon^2}} \quad (5)$$

Normally, equation (5) would only be useful for determining the direction of the omitted variable bias. However, by using a secondary data set that surveys high school seniors' career interests and tracks them into college, I can estimate values for the terms in equation (5). By making some plausible assumptions, I am able to find a lower bound point estimate for  $\beta_4$ .

Using this secondary data set, the previously mentioned NELS data, I construct a dummy variable  $X_{3i}$  that is equal to one if the individual revealed an interest in a teaching career during the senior year of high school. As described in Section 5.3, I set  $X_{3i}$  equal to one if the individual chose "school teacher" as his or her likely occupation at age thirty or some sort of education field as his or her likely college major; otherwise,  $X_{3i}$  equals zero.  $X_{3i}$  will equal one if the latent variable,  $X_{3i}^*$ , exceeds some threshold.  $X_{3i}^*$  is simply an indicator variable, so its scale is arbitrary. Given that  $\sigma_u^2$  is assumed to equal one in equation (4), I can re-write this equation as a valid probit model:

$$X_{3i}^* = \gamma_0 + X_{1i}\gamma_1 + X_{2i}\gamma_2 + \gamma_4 X_{4i} + D_j\gamma_5 + u_{ij} \quad (4')$$

$$X_{3i} = 1 \text{ if } X_{3i}^* \geq c, \quad X_{3i} = 0 \text{ if } X_{3i}^* < c$$

where  $\text{Var}(u_{ij}) = \sigma_u^2 = 1$  and  $c$  is some constant.

I use the NELS data to estimate  $\gamma_4$  in the probit model specified in equation (4').<sup>13</sup> I have assumed that  $\sigma_u^2$  equals one, and  $\sigma_\varepsilon^2$  is also normalized to one for probit estimation of equation (1).

Therefore, to solve for  $\beta_4$  in equation (5), the only remaining parameter to estimate is  $\beta_3$ .

Though I cannot estimate  $\beta_3$  directly, I find an upper bound value for  $\beta_3$  by using information revealed from the two data sets. I can estimate an upper bound for  $\beta_3$  equal to  $E[P_{ij}|X_{3i}=1] - E[P_{ij}|X_{3i}=0]$ , the difference in the mean entry rates into teaching between those who were and were not originally interested in a teaching career when they were seniors in high school. This is an upper bound for  $\beta_3$ , because the correlation between the other independent variables in equation (1) and  $X_{3i}$  is likely to be in the same direction as the correlation between these independent variables and  $P_{ij}$ . In other words, things that positively influence whether one becomes a teacher also positively influence whether one is likely to have had an interest in teaching at an earlier age.

This difference in entry rates,  $E[P_{ij}|X_{3i}=1] - E[P_{ij}|X_{3i}=0]$ , can be estimated using the two data sets. First, using my secondary data set (NELS), I can find an upper bound for the mean fraction of those interested in high school who persist in their pursuit of teaching careers,  $E[P_{ij}=1|X_{3i}=1]$ . Though I do not know the actual career outcomes, interest in teaching in the follow-up year of sophomore year of college serves as a good proxy for actually going on to teach *for those who were already interested during high school*. Let  $S_{ij}$  be a dummy variable equal to one if the individual reveals an interest in a teaching career during the sophomore year of college, where interest is defined in the same fashion as for  $X_{3i}$ . I use  $E[S_{ij}=1|X_{3i}=1]$  as an upper bound estimate for  $E[P_{ij}=1|X_{3i}=1]$ . I argue that this measure is an upper bound, because the attrition rate from interest in a teaching career is likely higher than the re-

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<sup>13</sup> All control variables that I use to estimate this model are identical to the corresponding estimation of equation (3) using the B&B data, except for one. Due to availability, I replace the dummy variable indicating whether either of

entry rate, i.e., it is probably the case that more individuals with  $X_{3i}=1$  and  $S_{ij}=1$  end up with  $P_{ij}=0$  than those with  $X_{3i}=1$  and  $S_{ij}=0$  end up with  $P_{ij}=1$ . Further support for using  $E[S_{ij}=1|X_{3i}=1]$  as a proxy for  $E[P_{ij}=1|X_{3i}=1]$  is provided by the finding that this produces similar estimates concerning entry into teaching as those found by Hanushek & Pace (1996).<sup>14</sup> I can then calculate  $E[P_{ij}=1]$  using my primary (B&B) data set and solve for

$$E[P_{ij} | X_{3i} = 0] = \frac{E[P_{ij}] - E[X_{3i} = 1] * E[P_{ij} = 1 | X_{3i} = 1]}{1 - E[X_{3i} = 1]} \quad (6)$$

It is worth noting that both of my interest in teaching measures,  $X_{3i}$  and  $S_{ij}$ , capture interest in teaching in either a public or private school. Though I will use these variables to estimate the unbiased value of  $\beta_4$  for some models in which the dependent variable equals one only if an individual teaches in a public school, the magnitude of the omitted variable bias is probably measured more accurately in models where the dependent variable also equals one if an individual becomes a private school teacher.

### 6.3 Baseline Results Ignoring the Omitted Variable Bias

I conduct maximum likelihood estimation of each probit model based on equation (3), using the B&B sample probability weights and adjusting standard errors for clustering at the college level. Inclusion of the sample weights is necessary due to endogenous sample stratification. Accounting for these weights, I estimate robust standard errors as derived by Wooldridge (1999).

As a baseline, one may estimate equation (3) using the full, top-3 rating group sample, and defining  $P_i$  as whether the individual teaches in a public school by 1997. For this model containing all of the top 3 groups, I add dummy variables for the Barron's selectivity rating level of the individual's college as control variables and also add state dummy variables. The results for this model are presented in Table 4. As expected,  $\theta_4$  is positive (see first row), which means that attending a college with a four-

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the individual's parents was born in a foreign country with a dummy variable indicating whether any language other than English is spoken at the individual's home.

<sup>14</sup> Hanushek & Pace (1996) estimate that only about 40% of recent college graduates who taught in the mid-1980's reported that they were interested in a teaching career when they were high school students. In the NELS data that I use, the fraction of sophomores interested in teaching who were also interested in teaching when they were high school seniors is 18%, 38%, 39%, and 50% respectively from the most selective to the least selective rating groups (where the last group includes all schools in the fourth-highest category or lower).

year undergraduate certification program is positively associated with entry into public teaching. Using the estimated average marginal effect<sup>15</sup> associated with  $\theta_4$ , a student attending a college with a UTCP is 3.4% more likely to enter teaching (compared to a mean likelihood of just under 10%).

As discussed in Section 3, one would expect the presence of UTCP's to have varying impacts for students attending colleges in different selectivity groups. Thus, a better specification for finding the impact of UTCP's is to estimate equation (3) separately for each rating group. The estimates of the  $\theta_4$  coefficients for various rating groups and various teaching outcomes are displayed in Table 5. In addition to point estimates, Table 5 reports the average marginal effect of UTCP's for each group. Regardless of the teaching outcome used as the dependent variable, the coefficient estimates in Table 5 are only statistically significant when the sample is limited to the second highest rating group. Table 5a shows that having a UTCP is associated with higher rates of entry into public school teaching at statistically significant levels for individuals who attend a college in the second-highest rating group. Table 5b shows that having a UTCP is associated with an even larger effect on entry into *either* public or private school teaching for this group. This suggests that the relationship between certification opportunities and entry into public school teaching is not simply due to a shifting away from the private sector to the public sector; availability of public school certification opportunities is associated with higher rates of entry into private school teaching.<sup>16</sup> Additional regressions (not reported here) reveal that, for the second-highest college rating group only, the availability of UTCP's is associated with a statistically significant increase in the fraction of individuals who teach in public schools *and* report that they intend to remain working in schools for the long term.

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<sup>15</sup> All average marginal effect estimates in this paper may be interpreted as estimates of the population average marginal effect, because I weight the marginal effect estimated for each observation by that observation's inverse sample probability weight.

<sup>16</sup> Even if many private schools do not care whether a teacher is certified, there are several reasons why a UTCP might increase rates of entry into private school teaching: (i) Some individuals planning on teaching in private schools may choose to enroll in a UTCP program, in order to better prepare themselves for teaching or to bolster their resume. This experience may increase the likelihood that they remain interested in teaching when they graduate. (ii) Some individuals who believe that they would like to teach in a public school in the future might begin their careers at private schools. (iii) The presence of UTCP programs may spark interest in teaching among those

To ensure that  $\theta_4$  is picking up the effect of having a shorter program and not the effect of having more programs, I re-estimate the models of Table 5 with the addition of an independent variable to control for whether a college has both elementary and secondary programs or both types of four-year programs. The presence of both elementary and secondary programs is in fact associated with higher entry into teaching, but the inclusion of this variable has little effect on the results.<sup>17</sup> The estimated marginal effects and levels of statistical significance corresponding to the  $\theta_4$  point estimates remain very similar to those of Table 5. Interestingly, the presence of both elementary and secondary UTCP's does not have any significant effect beyond that of having a UTCP at one level and a longer program at the other level. One cannot read very much into this finding, since there is not much within-state variation between colleges offering both types of UTCP, only one type of UTCP, or neither type of UTCP. However, this finding loosely suggests that shortening both elementary and secondary programs from post-B.A. or fifth-year programs to 4-year undergraduate programs may not increase rates of entry into teaching by much more than shortening one type of program to a UTCP.

#### *6.4 Lower Bound Estimates of Causal Effects*

As described in section 6.2, I can now use these  $\theta_4$  estimates along with other estimated parameters in equation (5) to estimate  $\beta_4$ , the true effect of availability of UTCP's on the likelihood that graduates become teachers. Table 6 displays the estimated values for these parameters, estimates for  $\beta_4$ , and the average marginal effect implied by these  $\beta_4$  estimates. As discussed in section 6.2, my estimate of  $\beta_3$  is likely overstating the true magnitude of  $\beta_3$  so that these  $\beta_4$  estimates overcorrect for the bias. Since  $\beta_3$  is always positive, the direction of the bias is the same as the sign of  $\gamma_4$ , so that the correction for this bias is in the opposite direction of the sign of  $\gamma_4$ . In the usual case where  $\gamma_4 > 0$ , these adjusted marginal effects thus represent lower bound estimates for the true marginal effect. For the other cases where  $\gamma_4 < 0$ , the marginal effect estimates without the correction, (displayed in Table 5), may be

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who do not enroll in these programs, because there is accessible information about teaching careers (e.g. administrative assistants, peers enrolled in the program) or greater on-campus recruitment of teachers.

interpreted as the lower bound estimates of the true effect. For each model in Table 6, I display in bold the lower bound estimates for the average marginal effect of UTCP's on the likelihood that one becomes a teacher. These marginal effect estimates are slightly incorrect, because I am unable to correct for the omitted variable bias of estimates of the other observed, independent variables' coefficients.

Since only the second-highest rating group has statistically significant coefficients in Table 5, the estimates for the marginal effects in Table 6 for this group are the most interesting. These estimates remain quantitatively significant for entry into public school teaching. Based on the model that includes state fixed effects, column C of Table 6, I estimate that the availability of a UTCP increases the likelihood of entering public school teaching by at least 3.11 percentage points. If one changes the dependent variable to include private school teaching and conducts similar analyses, then this lower bound estimate increases to 9.53 percentage points. This increase may be due to more accurate adjustments for the omitted variable bias when private school teaching is included (discussed in the end of section 6.2), as well as the actual causal impact of UTCP's on entry into private school teaching (discussed in footnote 16). These estimates are both quite significant in magnitude when one considers that the mean entry rates among graduates from colleges in this rating group that did not offer a UTCP were 4.6% for public schools and 7.5% for public or private schools. Unfortunately, I am unable to calculate the standard errors for these estimates. I can simply observe that the corresponding estimates ignoring the omitted variable bias were statistically significant, and that estimates using an upper bound value for the size of the omitted variable bias remain quantitatively significant.

The marginal effect estimates for the highest rating group in Table 6 are not very informative. Since there are not enough positive outcomes in the data for this group to estimate coefficients for the state fixed effects model, it is worth verifying that the effect for the most academically talented students would not be much larger if state dummy variables were included. In order to expand the sample size of the most academically talented students, I divided students in the top three rating groups who took the

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<sup>17</sup> The inclusion of a variable indicating whether a college offers a combined certification-Master's degree program also has no significant effect on the results.

SAT into three equally sized groups based on their SAT scores. For students in the top third of SAT scores (students scoring 1230 and above), the estimated coefficient on the UTCP variable in the probit model with state fixed effects is positive, but remains statistically insignificant. This additional result suggests that one would likely find a positive, but small, baseline estimate if one could estimate the model with state fixed effects for the highest rating group.

For the third-highest college rating group, almost all of the marginal effect estimates in Table 6 are negative. Furthermore, the estimated marginal effect for the model that includes state effects (column C) is quite large in magnitude: -5.41 percentage points. There is little reason to believe that the presence of UTCP's would have a substantial, negative impact on entry into teaching. This suggests that either my estimate of  $\theta_4$  for this group is too low, or that the estimates of  $\gamma_4$  or  $\beta_3$  in equation (5) may significantly overstate the true values. One plausible explanation is that UTCP's have little causal effect on entry into teaching for this group and that the observed control variables eliminate much of the potential omitted variable bias. If the latter phenomenon is also true for the second-highest rating group, then the causal impact of UTCP's on entry into teaching may be much larger for this group than the lower bound estimates suggest.

### *6.5 Other Interactions*

The impact of a UTCP on entry into teaching should vary, because certain types of individuals will be more likely to be on the margin concerning whether to teach and because the opportunity cost associated with pursuing teacher certification after college graduation will also vary. One would thus want to know how each of the within rating group estimates of Tables 5 and 6 changes when the sample is limited to certain types of individuals or types of colleges. However, dividing the sample by college selectivity rating group and then again along another dimension would not yield enough positive outcomes to allow these effects to be identified, especially when state fixed effects are included. In order to gain information about the likely qualitative changes to the estimates, I estimate models similar to Table 4 using all students in the top three rating groups, but dividing the sample along various dimensions. The results are presented in Appendix 2. One interesting finding is that the relationship

between a college having a UTCP and entry into public school teaching is stronger among public colleges. This relationship is also stronger for colleges in states that do not allow emergency certification or states that do not require a major or minor within the specific subject for secondary certification. UTCP's also have a larger effect on entry into public school teaching for colleges in which graduates are likely to reside<sup>18</sup> in states where there are greater requirements for student teaching, relatively low starting salaries for teachers, and relatively low salary premiums associated with first year teachers possessing a Master's degree. These findings generally suggest that UTCP's may be more likely to stimulate entry into teaching when it is relatively easy to balance UTCP coursework within one's undergraduate studies and when the financial return to pursuing certification after graduating from college is relatively low.

## **7. Discussion**

The previous section's results suggest that whether a college offers a four-year undergraduate teacher certification program (UTCP) has a significant, causal effect on entry into teaching for individuals attending colleges in the second-highest college selectivity rating category. Regardless of the control variables included, the estimates presented in Tables 5 and 6 suggest that UTCP's have a causal, positive impact on entry into teaching only for the second-highest rating group. Why does one observe this non-monotonic relationship between college selectivity and the causal impact of UTCP's? As discussed in Section 3, for the highest rating group, the small effect is likely related to the fact that so few of these individuals are on the margin for deciding whether to teach. For the third-highest group, this weak relationship might be explained by another finding: many students at these colleges are unable to complete their Bachelor's degree or teacher certification within four years. This renders shorter certification programs useless.

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<sup>18</sup> I calculate migration probabilities for recent college graduates using an outside data source, the 1990 Census Public-Use Micro-Sample, in order to avoid potential correlation between observed labor behavior and migration.



Do the large cross-sectional estimates for colleges in the second-highest rating group suggest that these colleges should add UTCP's in order to improve the quality of public school teaching? To answer this, one must consider the other general equilibrium effects from the addition of UTCP's, as well as the quality of training and preparation offered by UTCP's. Since there is currently no source of empirical evidence on how greater interest in teaching among graduates from highly selective colleges would change teacher labor markets, one can only speculate about these other general equilibrium effects. The addition of a UTCP's at colleges in the second-highest rating group would not have much impact on the national teacher supply curve. Consider the extreme case in which every college in the second-highest rating group was forced to have a UTCP and graduates from these colleges who obtain certification replace potential teachers from less selective colleges one-for-one. Based on my cross-sectional estimates for the state-fixed effect models in column C of Table 5 and Table 6, the fraction of new, young public school teachers who graduated from colleges in the highest two rating groups (roughly the top 15% of all graduates) would only increase from 9.1% to either 10.4% or 11.2%.

Though this change may be a "drop in the bucket" on a national scale, one college adopting a UTCP may in fact have a significant effect on a local or state teacher supply curve if graduates tend to remain in this area. In a competitive labor market, one would expect employee compensation (wages, benefits, conditions, etc.) for workers of a given ability to fall as a result of a decrease in the entry cost of this type of labor. However, the public school teacher labor market is far from competitive. School districts are usually constrained to offer all teachers the same salary schedule, and unions often have a large influence on labor contracts. Thus, it may be the case that a more attractive pool of potential teachers causes some school districts to raise salaries to compete for the better ones. It may also be the case that some school districts will lower salaries because they have an easier time finding certified teachers due to an increase in the total supply. The direction of salary movements, the types of districts that experience these salary movements, and the supply elasticities of various types of potential teachers will collectively either reinforce or diminish the change in interest in teaching among graduates from selective colleges.

Even if salaries remain constant due to the rigidity of the labor market, there remains the issue of which people interested in teaching will gain employment. One of the benefits of expanding interest in teaching among the academically talented may be the expansion of aggregate teacher supply to help school districts replace the “baby-boom” teachers expected to retire over the next decade. In many regions, the increased interest in teaching might simply offset the projected rise in the rates of teacher retirement and increases in the relative size of the school-aged population (Hussar, 1999). Teacher shortages are already so severe in some urban districts that they have recently had to recruit teachers from foreign countries. In areas that do not experience a rise in the net demand for teachers but that do currently allow emergency-certified teachers, these emergency-certified teachers are likely the ones who would be crowded out in the long-run, as districts will be forced to hire certified teachers. This could in turn lead individuals who formerly entered teaching through the emergency-certification route to pursue certification prior to teaching, pursue teaching jobs in private schools, or not pursue teaching at all. In other areas, to the extent that public schools “hire the best,” the increased supply of potential teachers who graduate from selective colleges could crowd out teachers with less impressive backgrounds. The myriad potential general equilibrium effects<sup>19</sup> prevent one from making any precise claims about how the fraction of individuals from selective colleges in particular types of school districts would change.

An additional consideration in analyzing the benefits of adding UTCP’s at certain colleges is that teacher quality will also be influenced by training. While there is a general consensus that teacher training can influence teacher quality, there is a longstanding debate over the ideal extent and nature of this training. In their review of the school productivity literature, Monk & Rice (1999) find that teacher coursework in both content area and pedagogical skills are important, but that there are diminishing returns to training in the content area. They also report that “research shows the relationship between

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<sup>19</sup> Another potential general equilibrium effect is changes in college attendance patterns. Potential changes in college attendance decisions could cause cross-sectional estimates to understate the effect of adding UTCP’s on entry into teaching among graduates of selective colleges. In particular, the policy change could increase the likelihood that students with pre-existing interest in teaching attend selective colleges, since they no longer have to consider sacrifice other college characteristics (e.g. prestige, tuition, location) for the availability of certification programs.

graduate studies and teaching effectiveness to be modest (p. 132).” These findings both imply that there may be sufficient time within an undergraduate’s four years to replace some of the higher level subject courses or electives with courses aimed more specifically at future teachers, without compromising the teaching abilities of those pursuing certification.

This paper’s findings also support the idea that, holding teacher salaries and working conditions constant, relaxing certification requirements could increase the supply of teachers by lowering entry costs. Of course, there would be many additional general equilibrium effects associated with lowering certification requirements or increasing alternative certification routes. Whether the net effect of these policy changes would increase or decrease the overall quality of teachers is ambiguous.

## **8. Conclusion**

This paper finds that adding undergraduate teacher certification programs that may be completed within four years would positively impact the supply of public school teachers from certain selective colleges. These programs could increase the average rate of entry of graduates from these colleges into public school teaching by at least 50%, provided that greater interest in teaching among these individuals would not lead to perverse general equilibrium effects due to changes in local labor markets. The addition of these programs would also likely increase the fraction of these individuals who pursue long-term careers in public schools and the fraction who become private school teachers. Though academic ability is just one aspect of teacher quality, increasing availability of undergraduate teacher certification programs may be a way to expand the supply of teachers and to improve the distribution of academic ability among teachers without sacrificing other characteristics, such as teacher preparation.

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Table 1a: Composition of Undergraduates, Recent Graduates, and Recent Graduates Who Teach by Selectivity of Their Colleges

	Barron's College Selectivity Rating			
	Most Competitive	Highly Competitive	Very Competitive	Top 3 Groups Combined
% of All Undergraduates	2.5%	7.4%	17.7%	27.6%
% of All College Graduates	4.3%	11.3%	26.7%	42.3%
% of All College Graduates who Enter Teaching within 4 years	3.9%	8.2%	25.1%	37.2%
% of All College Graduates who Enter Public School Teaching within 4 years	1.9%	7.2%	25.8%	34.9%
% of All College Graduates who Enter Public School Teaching and plan on Long-Term Careers in K-12 Education	1.0%	7.3%	25.5%	33.9%

Table 1b: Rates Within Selectivity Groups by which Graduates Reach Various Teaching Outcomes

	Barron's College Selectivity Rating			
	Most Competitive	Highly Competitive	Very Competitive	Top 3 Groups Combined
% Who Enter Teaching within 4 years	14.6%	11.5%	14.9%	14.0%
% Who Enter Public School Teaching within 4 years	5.1%	7.5%	11.3%	9.7%
% Who Enter Public School Teaching and plan on Long-Term Careers in K-12 Education	1.9%	5.1%	7.6%	6.4%

Notes to Table 1: Undergraduate percentages are based on IPEDS data for total undergraduate enrollments in all non-military colleges during the 1992-93 school year. Percentages of graduates are based on (sample-weighted) B&B data for individuals who graduated during the 1992-93 school year, excluding students who attended military colleges, entered college after the age of 21, or graduated after the age of 29.

Table 2: Undergraduate Enrollment Breakdowns by Barron’s College Selectivity Rating and the Types of Teacher Certification Programs Offered

Types of Teacher Certification Programs Offered	Barron’s Rating Group		
	Most Competitive (48 colleges)	Highly Competitive (85 colleges)	Very Competitive (245 colleges)
4-year Certification Program (Either Elementary or Secondary or Both)	54%	57%	81%
<u>Elementary Certification</u>			
Any	57%	89%	91%
4-year	38%	53%	74%
< 5 year	46%	61%	75%
Joint M.A.	42%	48%	61%
<u>Secondary Certification</u>			
Any	84%	93%	98%
4-year	49%	53%	72%
< 5 year	61%	61%	79%
Joint M.A.	59%	63%	69%
<u>Elementary/Secondary Combinations</u>			
4-year Elementary, Any Secondary	57%	53%	73%
4-year Elementary, 4-year Secondary	33%	50%	65%
Any Elementary, Any Secondary	38%	89%	91%
Any Elementary, 4-year Secondary	41%	51%	66%

Notes to Table 2: Example of Interpretation: 89% of undergraduates enrolled at Highly Competitive Colleges are enrolled at colleges offering any elementary teacher certification program. Percentages are based on IPEDS enrollment data for all non-military colleges. “<5 year” includes all schools with 4-year programs, as well as others that require less than a full fifth year. For example, some programs require nine semesters or require eight regular semesters plus summer classes.

Table 3: Descriptive Statistics for Independent Variables:  
Population Means with Population Standard Deviations in Italics

Independent Variables	All Top-3 Rating Groups	(1) Most Competitive	(2) Highly Competitive	(3) Very Competitive
College offers any undergraduate teacher certification program?	.735 <i>.441</i>	.459 <i>.499</i>	.583 <i>.493</i>	.844 <i>.362</i>
Institutional Characteristics				
Public College?	.589 <i>.492</i>	.18 <i>.38</i>	.55 <i>.50</i>	.67 <i>.47</i>
Religiously Affiliated?	.191 <i>.393</i>	.07 <i>.25</i>	.17 <i>.37</i>	.22 <i>.41</i>
Ph.D. Offered in Any Subject?	.704 <i>.456</i>	.78 <i>.41</i>	.85 <i>.36</i>	.63 <i>.48</i>
Undergraduate Enrollment	16,268 <i>12,772</i>	6,938 <i>4,023</i>	18,582 <i>11,826</i>	16,782 <i>13,424</i>
Individual Characteristics				
Minority (Non-white) AND Male	.074 <i>.262</i>	.12 <i>.32</i>	.09 <i>.29</i>	.06 <i>.24</i>
Minority AND Female	.080 <i>.272</i>	.10 <i>.30</i>	.09 <i>.28</i>	.07 <i>.26</i>
White AND Male	.420 <i>.494</i>	.45 <i>.50</i>	.40 <i>.49</i>	.42 <i>.49</i>
Only SAT Score Available	.53 <i>.50</i>	.72 <i>.45</i>	.56 <i>.56</i>	.48 <i>.50</i>
SAT Verbal Score if only took SAT	574 <i>96</i>	664 <i>79</i>	578 <i>92</i>	550 <i>87</i>
SAT Math Score if only took SAT	570 <i>93</i>	655 <i>73</i>	581 <i>87</i>	545 <i>86</i>
Only ACT Score Available	.16 <i>.37</i>	.01 <i>.09</i>	.15 <i>.35</i>	.19 <i>.39</i>
ACT Score if only took ACT	23 <i>4.3</i>	28 <i>4.5</i>	24 <i>3.9</i>	23 <i>4.3</i>
Both Scores Available	.15 <i>.36</i>	.09 <i>.29</i>	.15 <i>.36</i>	.17 <i>.37</i>
SAT Verbal Score with ACT also available	562 <i>93</i>	661 <i>69</i>	591 <i>86</i>	541 <i>89</i>
SAT Math Score with ACT also available	571 <i>88</i>	671 <i>74</i>	602 <i>82</i>	549 <i>82</i>
ACT Score with SAT also available	25 <i>4.9</i>	29 <i>4.1</i>	27 <i>4.2</i>	24 <i>4.8</i>
Parental Characteristics				
Mother: BA only	.30 <i>.46</i>	.35 <i>.48</i>	.32 <i>.46</i>	.28 <i>.45</i>
Father: BA only	.30 <i>.46</i>	.31 <i>.46</i>	.31 <i>.46</i>	.29 <i>.46</i>
Mother: Grad Degree	.18 <i>.39</i>	.35 <i>.48</i>	.19 <i>.39</i>	.15 <i>.36</i>
Father: Grad Degree	.32 <i>.47</i>	.51 <i>.50</i>	.34 <i>.47</i>	.28 <i>.45</i>
Either parent: High School Dropout	.06 <i>.23</i>	.02 <i>.15</i>	.06 <i>.23</i>	.06 <i>.24</i>
Either parent: Foreign Born	.17 <i>.37</i>	.24 <i>.43</i>	.20 <i>.40</i>	.14 <i>.35</i>

Notes to Table 3: Statistics are based on Baccalaureate and Beyond (B&B) data, using sample probability weights.



Table 4: Factors Influencing Entry of College Graduates into Public School Teaching:  
 Probit Estimates Using B&B Data for Graduates from Colleges in Barron's Top 3 Selectivity Rating Groups

Dependent Variable: Dummy for whether individuals receiving B.A. in 1994 taught in a public school by 1997

Independent Variables	Coefficient	Standard Error
College offers any undergraduate teacher certification program? ( $X_{4i}$ )	.254*	.128
Institutional Characteristics		
College is in Most Competitive Rating Group(1)?	.117	.169
College is in Highly Competitive Rating Group(2)?	-.120	.117
Public College?	.212	.213
Religiously Affiliated?	-.081	.134
Ph.D. Offered in Any Subject?	-.288**	.105
Undergraduate Enrollment	$1.2*10^{-5}$	$3.2*10^{-5}$
(Undergrad. Enroll)^2	$-1.12*10^{-9}$	$1.51*10^{-9}$
(Undergrad. Enroll)^3	$1.73*10^{-14}$	$2.09*10^{-14}$
Individual Characteristics		
Minority (Non-white) AND Male	-.679**	.164
Minority AND Female	-.031	.172
White AND Male	-.582**	.088
Both SAT and ACT Scores Available	.887	.616
Only SAT Scores Available	.543	.460
Only ACT Scores Available	-.172	.383
SAT Verbal Score (100's)	-.016	.079
SAT Math Score (100's)	-.104	.072
SAT Verbal Score (100's) with ACT also Available	-.202	.131
SAT Math Score (100's) with ACT also Available	-.024	.127
ACT Score	.014	.016
ACT Score with SAT also available	.016	.034
Parental Characteristics		
Mother: Has B.A. Only	-.341**	.074
Father: Has B.A. Only	.084	.102
Mother: Has Graduate Degree	-.168	.106
Father: Has Graduate Degree	.070	.103
Either parent: High School Dropout	-.156	.133
Either parent: Foreign Born	-.109	.127
N = 3,061	Pseudo R-squared = .109	

+ significant at 10%; \* significant at 5%; \*\* significant at 1%

Notes to Table 4: Uses B&B data with sample probability weights. Excludes graduates from colleges not offering any certification programs, as well as graduates who were over the age of 21 when they began college or over the age of 29 when they graduated. Independent variables also include state dummy variables and an intercept term. Standard errors are robust and adjust for clustering at the college level.

Table 5a: Relationship Between Colleges Offering any Undergraduate Teacher Certification Program and Graduates Becoming Public School Teachers  
 Dependent Variable: Dummy for whether individuals receiving B.A. in 1994 taught in a public school by 1997

	(A)	(B)	(C)
Most Competitive Colleges (Highest Rating Group)			
# of Observations	300		
Estimate	-.173	Not enough positive	Not enough positive
Standard Error	.226	outcomes to identify.	outcomes to identify.
Avg. Marginal Effect	-.0143		
Highly Competitive Colleges (2 <sup>nd</sup> Highest Rating Group)			
# of Observations	801	801	751
Estimate	.309	.316	.698
Standard Error	.181	.177	.390
Avg. Marginal Effect	.0367	.0361	.0777
Very Competitive Colleges (3 <sup>rd</sup> Highest Rating Group)			
# of Observations	2001	2001	2001
Estimate	.188	.212	.049
Standard Error	.147	.179	.181
Avg. Marginal Effect	.0312	.0348	.0082
Geographic Controls:	None	Regional Dummies	State Dummies

Table 5b: Relationship Between Colleges Offering any Undergraduate Teacher Certification Program and Graduates Becoming Teachers  
 Dependent Variable: Dummy for whether individuals receiving B.A. in 1994 taught by 1997

	(A)	(B)	(C)
Most Competitive Colleges (Highest Rating Group)			
# of Observations	300		
Estimate	.093	Not enough positive	Not enough positive
Standard Error	.114	outcomes to identify.	outcomes to identify.
Avg. Marginal Effect	.0178		
Highly Competitive Colleges (2 <sup>nd</sup> Highest Rating Group)			
# of Observations	801	801	780
Estimate	.204	.320	.993
Standard Error	.130	.169	.225
Avg. Marginal Effect	.0361	.0545	.1592
Very Competitive Colleges (3 <sup>rd</sup> Highest Rating Group)			
# of Observations	2001	2001	2001
Estimate	.139	.194	.117
Standard Error	.126	.152	.160
Avg. Marginal Effect	.0287	.0390	.0233
Geographic Controls:	None	Regional Dummies	State Dummies

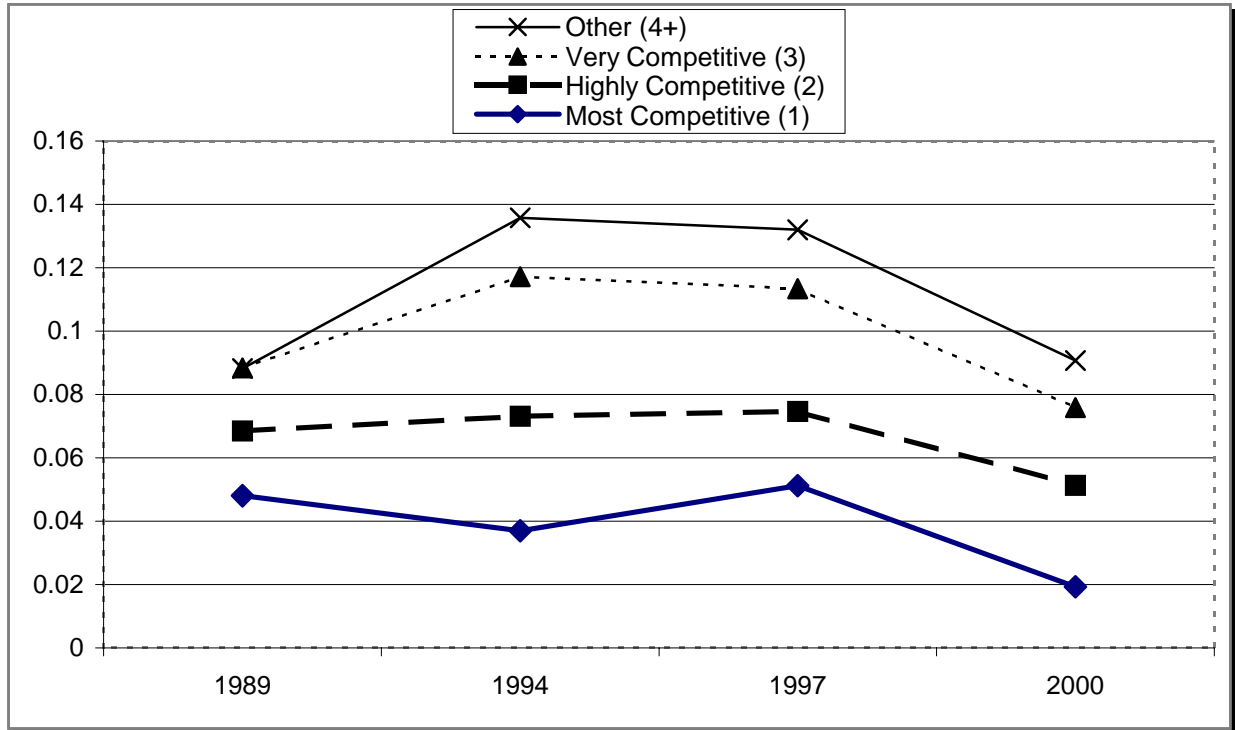
Notes to Table 5: Estimates are point estimates of  $\theta_4$  in equation (3) from probit estimation using (sample-weighted) B&B data divided by college rating group. I applied the same sample restrictions described in the Notes to Table 4. Standard errors are robust and adjust for clustering at the college level.

Table 6: Lower Bound Estimates for the Causal Effect of Colleges Offering an Undergraduate Teacher Certification Program on the Likelihood that Graduates Become Public School Teachers

	(A)	(B)	(C)
<b>Most Competitive Colleges (Highest Rating Group)</b>			
# of NELS Observations	204		
$\gamma_4$	-1.66		
<i>Standard Error of <math>\gamma_4</math></i>	.633		
$\hat{\beta}_3$ (upper bound estimate for $\beta_3$ )	.573	Not enough positive outcomes to identify.	
$\hat{\beta}_4$	.750		
(Sample-Weighted) Average Value of $\frac{dP_{ij}}{d\hat{\beta}_4}$	.1150		
<b>Lower Bound for Average Marginal Effect</b>	<b>-.0143</b>		
<b>Highly Competitive Colleges (2<sup>nd</sup> Highest Rating Group)</b>			
# of NELS Observations	546	525	512
$\gamma_4$	-.094	.344	.873
<i>Standard Error of <math>\gamma_4</math></i>	.259	.250	.454
$\hat{\beta}_3$ (upper bound estimate for $\beta_3$ )	.486	.486	.486
$\hat{\beta}_4$	.389	.184	.352
(Sample-Weighted) Average Value of $\frac{dP_{ij}}{d\hat{\beta}_4}$	.0488	.0192	.0311
<b>Lower Bound for Average Marginal Effect</b>	<b>.0367</b>	<b>.0192</b>	<b>.0311</b>
<b>Very Competitive Colleges (3<sup>rd</sup> Highest Rating Group)</b>			
# of NELS Observations	998	968	900
$\gamma_4$	.512	.607	.785
<i>Standard Error of <math>\gamma_4</math></i>	.217	.229	.309
$\hat{\beta}_3$ (upper bound estimate for $\beta_3$ )	.612	.612	.612
$\hat{\beta}_4$	-.093	-.123	-.423
(Sample-Weighted) Average Value of $\frac{dP_{ij}}{d\hat{\beta}_4}$	-.0130	-.0163	-.0541
<b>Lower Bound for Average Marginal Effect</b>	<b>-.0130</b>	<b>-.0163</b>	<b>-.0541</b>
Geographic Controls:	None	Regional Dummies	State Dummies

Notes to Table 6: Estimates use (sample-weighted) NELS and B&B data, divided by Barron's college selectivity rating group. See Section 6.2 for definitions of the parameters and Section 6.4 for a description of these results. For each column, I display in bold the (sample-weighted) average marginal effect corresponding to the relevant lower bound point estimate for the causal effect of an undergraduate teacher certification program on the likelihood that one becomes a teacher.

Figure 1: Fraction of Individuals in the College Class of '93 Revealing a Potential Long Term Interest in Teaching: Sorted by Barron's Selectivity Rating of their College



Notes to Figure 1: The “1989” rates are actually based on (sample-weighted) NELS data for the high school class of 1988, while the later data points are based on (sample-weighted) B&B data for the college class of 1993. The “2000” rates are based on a forward-looking question asked in 1997. See Section 5.3 for more details.

Figure 2: Fraction of Individuals in the College Class of '93 Revealing a Potential Long Term Interest in Teaching: Sorted by Barron's College Selectivity Rating and Whether Their College Offered a 4-year, Undergraduate Teacher Certification Program (yes/no)

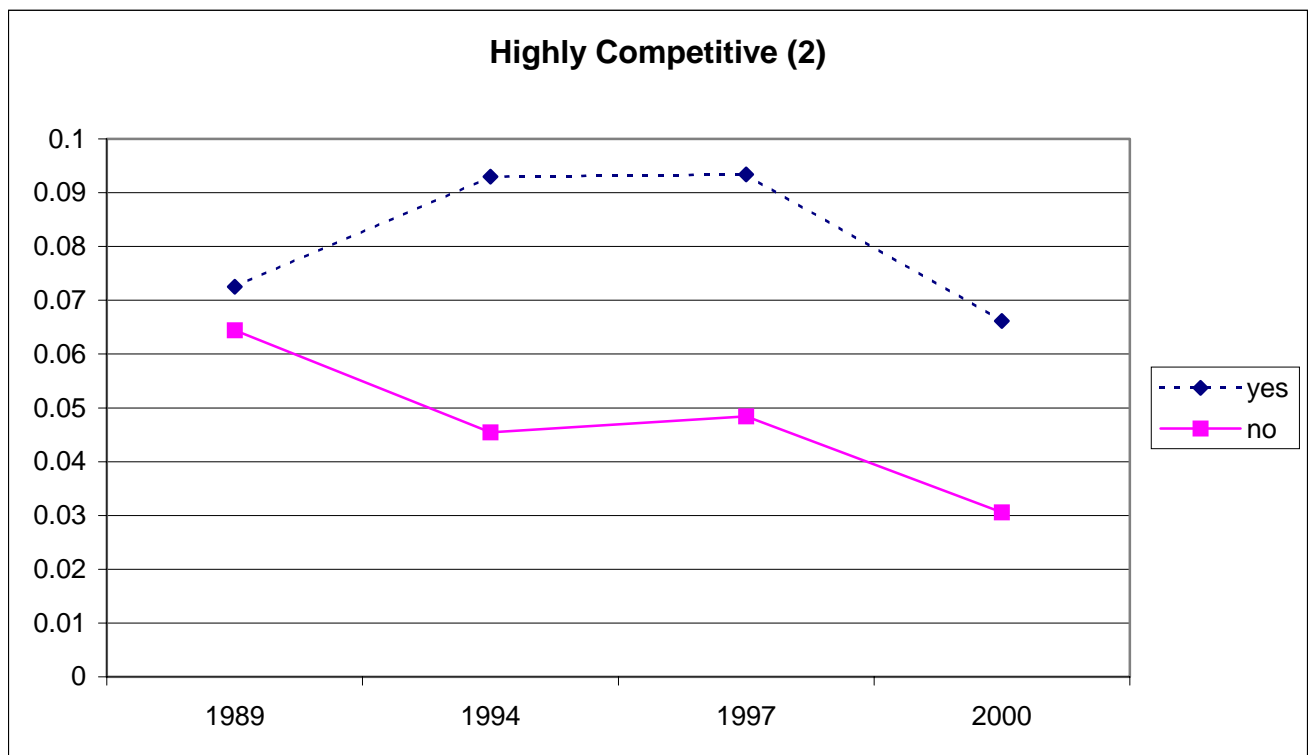
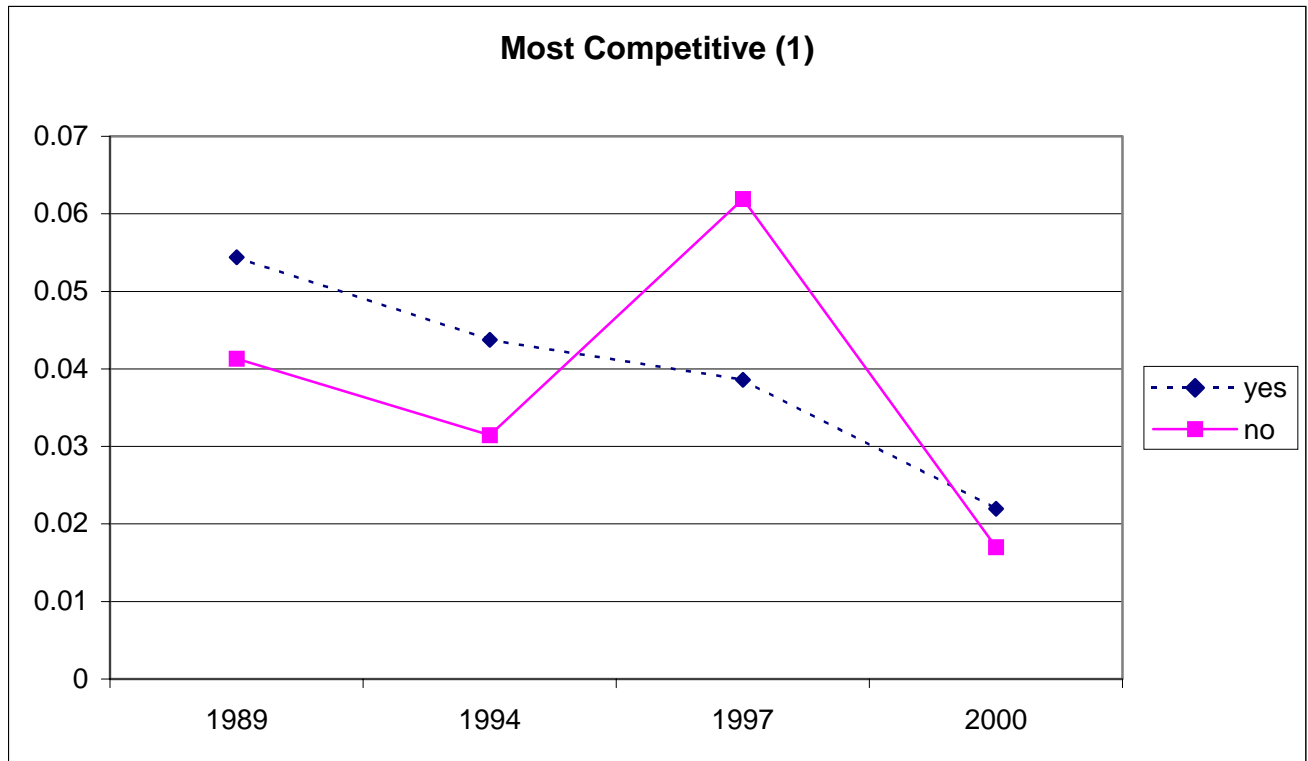
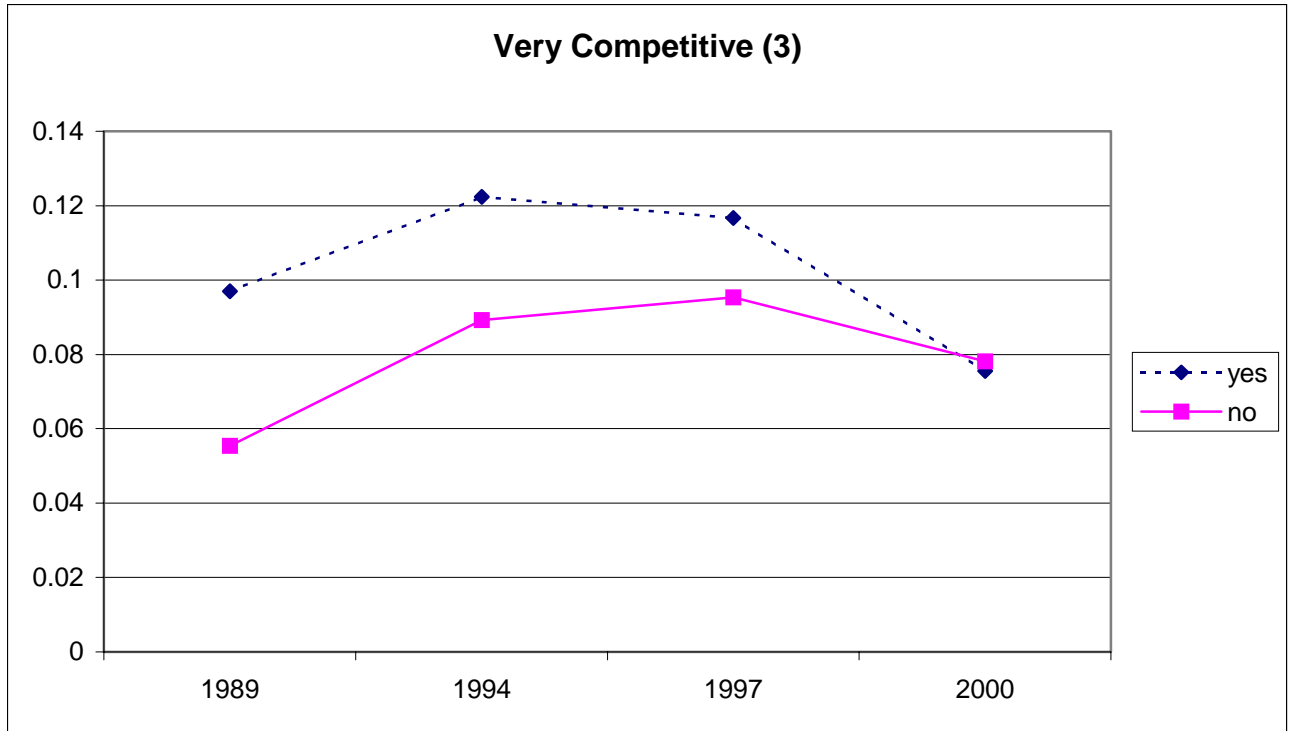


Figure 2 (cont.) Fraction of Individuals in the College Class of '93 Revealing a Potential Long Term Interest in Teaching:  
Sorted by Barron's College Selectivity Rating and Whether Their College Offered a 4-year, Undergraduate Teacher Certification Program (yes/no)



Notes to Figure 2: The “1989” rates are actually based on (sample-weighted) NELS data for the high school class of 1988, while the later data points are based on (sample-weighted) B&B data for the college class of 1993. The “2000” rates are based on a forward-looking question asked in 1997. See Section 5.3 for more details.

### Appendix 1: Examples of Similar Colleges with Different Certification Offerings

Barron's Selectivity Rating Group	Does College Offer 4-year UTCP?		Similarity
	YES	NO	
Most Competitive	University of Virginia	College of William & Mary	Public Schools in Virginia
“ “	Colgate University	Cornell University	Large New York Universities
“ “	Duke University	Stanford U.	Private Universities
Highly Competitive	U. of Michigan- Ann Arbor	U. of Wisconsin- Madison	Large Public Midwest Universities
“ “	Hamilton College	Oberlin College	Small Colleges with students with Similar Verbal SAT scores
Very Competitive	Cal-State Los Angeles	U. of California- San Diego	Public Southern Californian Universities

**Appendix 2: Marginal Effects<sup>a</sup> of UTCP when Interacted with Other Factors**  
 Probit Regressions<sup>b</sup> for Different Sample Groups, Including Graduates from Colleges in the  
 Top 3 Barron's Selectivity Rating Groups

Sample	Dependent Variable				
	Teach in Public School within 4 Years of College Graduation		Teach in Public School within 4 Years & Plan to Keep Working in Schools		
	Marg. Eff.	% Change <sup>a</sup>	Marg. Eff.	% Change <sup>a</sup>	
<b>All</b>	.031+	46%	.028**	56%	
Mother has at least A Bachelor's degree?	<b>Yes</b>	.023	55%	.020**	76%
	<b>No</b>	.037	41%	.028+	38%
SAT Verbal	<b>Top ½ (&gt;580)</b>	.030+	88%	.014+	59%
	<b>Lower ½</b>	.006	6%	.003	4%
SAT Math	<b>Top ½ (&gt;570)</b>	.018	63%	-.001	-4%
	<b>Lower ½</b>	.017	17%	.026	34%
SAT Score Missing & Took ACT		.067*	86%	.058+	141%
GENDER	<b>MALE</b>	.024+	67%	.002*	8%
	<b>FEMALE</b>	.022	23%	.042+	56%
RACE	<b>WHITE</b>	.025	34%	.028	52%
	<b>NONWHITE</b>	.019	45%	Unidentified	
COLLEGE CONTROL	<b>PUBLIC</b>	.072*	96%	.026	45%
	<b>PRIVATE</b>	.021	45%	.028**	89%
<b>State-Level Interaction</b>					
Allows Emergency Teacher Certification?	<b>Yes</b>	.005	8%	.006	11%
	<b>No</b>	.029	41%	.022+	51%
Requires Major/Minor in Field (secondary certification)?	<b>Yes</b>	-.001	-1%	.015	24%
	<b>No</b>	.017	33%	.045*	116%
<b>Migration-Probability Weighted Values for State Level Variables<sup>c</sup></b>					
Certification Course Requirements <sup>d</sup>	<b>Many</b>	.028	55%	.006	19%
	<b>Fewer</b>	.024	32%	.025	45%
Student Teaching Requirements <sup>e</sup>	<b>Many</b>	.041+	75%	.027*	56%
	<b>Fewer</b>	-.008	-10%	.013	24%
Average Starting Public School Teacher Salaries <sup>f</sup>	<b>Lower</b>	.043*	62%	.033**	63%
	<b>Higher</b>	.009	14%	.015	30%
Average Starting Salary Premium for Teachers Having a M.A. <sup>f</sup>	<b>Lower</b>	.041	59%	.026	54%
	<b>Higher</b>	.007	11%	.047*	91%

Statistical Significance of the corresponding point estimate: \*\* 1%, \* 5%, + 10% level

<sup>a</sup> Marginal effects in this table are calculated at the mean values of the independent variables for the relevant sample. % Change equals this marginal effect divided by the mean rate of the outcome for those within this sample.

<sup>b</sup> Independent variables include the institutional, individual, and parental controls listed in Table 3, as well as state fixed effects and a dummy variable concerning whether the individual's college offers both elementary and secondary programs (any duration). Like in the other models, the sample excludes undergraduates at colleges not offering any certification program.

<sup>c</sup> These measures capture characteristics in states where the individual is likely to locate after college graduation. Migration probabilities were calculated using an outside data source, the 1990 Census Public-Use Micro-Sample, in order to avoid potential correlation between observed labor behavior and migration. For each state-level variable, the sample is divided in half based on whether the individual attended college in a state where college graduates tend to have relatively high or low values for that variable.

<sup>d</sup> This is based on the average number of courses required by the state for elementary or secondary certification.

<sup>e</sup> This is based on the number of special requirements for student teaching in the state, where special requirements include having to student teach in multiple classrooms, having to student teach with special education students, and having to student teach while supervised by a master teacher.

<sup>f</sup> Estimates of state average starting public school teacher salaries are based on the NCES Schools and Staffing Survey. "Average Starting Public School Teacher Salaries" are based on first-year teachers without M.A.'s. "Average Starting Salary Premium for Teachers Having a M.A." is based on the ratio of starting salary with a M.A. divided by starting salary without a M.A.