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# Gains in Teacher Quality

## Academic capabilities of the U.S. teaching force are on the rise

The quality of the teacher workforce in the United States is of considerable concern to education stakeholders and policymakers. Numerous studies show that student academic success depends in no small part on access to high-quality teachers. Many pundits point to the fact that in the United States, teachers tend not to be drawn from the top of the academic-performance distribution, as is the case in countries with higher student achievement, such as Finland, Korea, and Singapore. And the evidence on the importance of teacher academic proficiency generally suggests that effectiveness in raising student test scores is associated with strong cognitive skills as measured by SAT or licensure test scores, or the competitiveness of the college from which teachers graduate.

If teacher academic proficiency matters, then the long-term trends in the makeup of the teacher workforce present a troubling portrait. Teaching is a female-dominated occupation, and prior to notable gender desegregation in the labor force beginning in the 1960s, the most academically capable female college graduates tended to become teachers. Over the course of the next 35 years, women still made up the vast majority of the teacher workforce, but their academic credentials began to decline. Research

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by Sean Corcoran, William Evans, and Robert Schwab indicates that the likelihood of a female teacher having been among the highest-scoring 10 percent of high school students on standardized achievement tests fell sharply between 1971 and 2000, from 24 to 11 percent.

Over the past 20 years, there has been a strong policy push toward getting smarter people into the teacher workforce. Enacted in 2001, No Child Left Behind (NCLB), for instance, emphasized academic competence by requiring that prospective teachers either graduate with a major in the subject they are teaching, have credits equivalent to a major, or pass a qualifying test showing competence in the subject. Newly created alternative pathways to certification have sought to bring more academically accomplished individuals into the profession. More recently, the Council for the Accreditation of Educator Preparation (CAEP) released new standards for teacher training programs: among them, each cohort of entrants should have a collective grade-point average (GPA) of 3.0 and college admission test scores above the national average by 2017 and in the top one-third by 2020.

Teacher applicants and new teachers in recent years have higher SAT scores than their counterparts in the mid-1990s.

Absent persuasive evidence on the impact of efforts to raise the bar, some people have speculated that the rise of test-based accountability associated with NCLB and the ongoing push to establish more-rigorous teacher evaluation systems have made teaching less attractive and thereby contributed to further decline in the quality of the teaching corps. Prominent education historian Diane Ravitch, for example, has gone so far as to allege that reformers are waging a "war on teachers" that threatens to undermine, rather than improve, teacher quality.

So how has the academic caliber of new teachers changed over the last two decades? Has the policy emphasis on teacher quality led more academically talented people into the teacher workforce, or have accountability reforms driven talent away?

In this article we use a variety of datasets to analyze trends in the academic proficiency of individuals at various points in the teacher pipeline over the last two decades. Our conclusions are generally encouraging, although they come with caveats and an acknowledgment that there is room for improvement when it comes to drawing more talent into teaching. Focusing on the start of the teacher pipeline, i.e., on those who report applying for a teaching job or teachers who begin classroom positions in the year immediately after receiving an undergraduate degree, we find that teacher applicants and new teachers in recent years have significantly higher SAT scores than their counterparts in the mid-1990s. Contrary to earlier cohorts of college graduates from the mid-1990s and early 2000s, graduates entering the teaching profession in the 2008–09 school year had average SAT scores that slightly exceeded average scores of their peers entering other occupations. What is less clear is whether this improvement reflects a temporary response to the economic downturn or a more permanent shift.

## The Teacher Workforce

We begin by using the Schools and Staffing Survey (SASS) data (see sidebar for a description of the datasets on which we rely) to provide an overview of demographic changes to the teacher workforce since the late 1980s. Teaching positions have traditionally been held primarily by white females, and despite some minor shifts over time, that remains overwhelmingly true today. A recent uptick in the proportion of teachers who are female, from about 71 percent in 1987–88 to about 76 percent in 2007–08, reflects growth in the number of female science and math teachers. In 1987–88 only about 38 percent of science teachers and 48 percent of math teachers were female, while in 2007–08 these figures rose to about 61 percent in science and 64 percent in math. We also find that the teachers in the workforce in 2007–08 had completed somewhat more schooling than their predecessors; approximately 51 percent held a master's degree or higher compared to 47 percent in 1987–88. But, as numerous studies have shown, having a master's degree is generally not correlated with measures of teacher effectiveness, based on student test scores.

The aging of the teacher workforce and the possibility of an impending teacher retirement "crisis" are recurring topics in the media. A 2009 *New York Times* article, for instance, noted that "Over the next four years, more than a third of the nation's 3.2 million teachers could retire, depriving classrooms of experienced instructors and straining taxpayer-financed retirement systems." The SASS data do show that the number of teachers eligible for full or partial retirement has increased dramatically. While the average age of teachers changed relatively little during this period, the percentage over age 55 increased from 9 to 16 percent. The pace at which the workforce is aging into retirement eligibility is also quickening: most of the increase in the proportion of retirement-eligible teachers occurred in the mid-2000s, and today the nation's classrooms are staffed predominantly by relatively junior (under age 30) and senior teachers (over age 55). Although the demand for teachers also depends

on policies such as class size and the use of technology, this increase in retirement-eligible teachers may well portend the need to hire more teachers in upcoming years.

## Prospective Teachers

To get a picture of changes to the pool of potential teachers, we merge institutional selectivity measures from the College Board with the Integrated Postsecondary Education Data System (IPEDS) data on yearly changes over time in the college majors of graduates.

As one's college major is a leading indicator of occupational intention, we explore trends in the average selectivity of colleges (measured based on the average SAT score for incoming freshmen) of those receiving a bachelor's degree with an education or a noneducation major. We find that prospective teachers are graduating from less-selective colleges than noneducation majors, and that in the last 20 years the gap in institutional selectivity between education and noneducation majors has widened. For instance, a comparison of the institution-level average SAT scores of incoming freshmen, weighted by the number of graduates with education and noneducation majors, shows a difference of about 10 points on both the SAT math and verbal test in 1990 and 20 points in 2010. Similar trends for education and noneducation majors are evident for other measures of college selectivity, such as the percentage of incoming freshmen ranking near the top of their high-school class.

In support of one explanation for this shift, Randall Reback has shown that more-selective colleges and universities have become less likely to offer undergraduate programs that allow students to earn teacher certification in

## The Data

As no single dataset provides a comprehensive picture of the teacher pipeline, we base our analyses on four different datasets: the Schools and Staffing Survey (SASS), the Integrated Postsecondary Education Data System (IPEDS), the Baccalaureate and Beyond Longitudinal Study (B&B), and data from the College Board. Each of these datasets has strengths and weaknesses when it comes to tracking the academic proficiency and training of individuals who are opting to pursue a career in teaching.

The SASS provides a nationally representative snapshot of districts, schools, and teachers in particular years: 1987–88, 1990–91, 1993–94, 1999–2000, 2003–04, and 2007–08. This dataset includes approximately 250,000 teacher observations over the six waves of the survey. The SASS provides a broad picture of how the demographic makeup of the teacher workforce is changing over time. But those who fill a teaching position must have both an expressed desire to teach (obtaining required credentials and apply to teaching positions) and have been selected for a teaching position by a school system. Thus, information about teachers in the SASS reflects both the preferences of teachers and hiring officials. Additionally, the SASS is limited in that it focuses only on in-service teachers; it does not provide information on how teachers compare to other college graduates.

The IPEDS consists of annual information from more than 7,500 institutions and is used to describe and analyze trends in postsecondary education in the United States. The IPEDS includes data on enrollments, degree completions, and graduation rates.

The B&B data provide nationally representative snapshots of three cohorts (one from 1993, followed up in 1994; one from 2000, followed up in 2001; and one from 2008, followed up in 2009) of more than 10,000 college graduates (in each wave of the survey) who are tracked into the workforce. We use these data to paint a more detailed picture of the teacher pipeline and of how those at various points in the pipeline compare to college graduates who choose a different occupation.

Data from the College Board include annual information on the number of applicants for approximately 6,000 two-year and four-year postsecondary institutions from 1990 to 2010, as well as institutional selectivity measures, such as class rankings, GPA, and ACT and SAT scores of incoming freshmen, averaged at the level of the institution. This institution-level dataset can be merged with each of the other datasets we utilize, providing a measure of the selectivity of colleges and universities from which teachers receive their credentials. It can also be merged with annual information from the IPEDS on the number of graduates by major and degree level. This allows us to assess whether there has been any change over the last 20 years in the academic proficiency of prospective teachers, i.e., those whose academic major in education suggests that they are interested in pursuing a teaching career. But, as we note, many of those whose major might suggest they are interested in teaching might not actually pursue a teaching career.

four years. This is consistent with another interesting finding from the IPEDS data, which show a shift in the way teachers are being prepared. The percentage of all bachelor's degrees that are in education dropped from about 10 percent in 1990 to about 6 percent in 2010, while the percentage of master's degrees that are in education stayed around 27 percent. Not surprisingly, given these figures, the share of prospective teachers gaining formal teacher preparation (i.e., a degree in education) through a graduate rather than undergraduate program has risen sharply over time, from about 45 percent in 1990 to about 63 percent in 2010. The SASS data confirm that there has been an increase in the number of master's credentials among newly hired teachers. Of teachers who report having one year or less of teaching experience, approximately 26 percent entered teaching with a master's degree in 2007–08 compared to 17 percent in 1987–88. This creates a dilemma when it comes to gaining a full understanding of how the teaching profession might be changing because, to our knowledge, there is no nationally representative dataset with information on the academic caliber of teachers who come into the profession with a master's degree, an increasingly important pathway into the teaching profession.

New teachers in classrooms with high-stakes testing tend to have higher SAT scores than those in other classrooms.

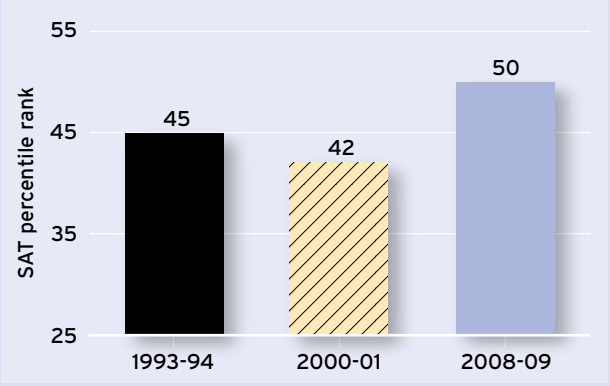
## New Teachers

The Baccalaureate and Beyond Longitudinal Study (B&B) data, however, give us a sense of which bachelor's degree recipients are actually entering teaching (as opposed to training to enter the profession) and other occupations by looking at cohorts that received their degrees in 1993, 2000, and 2008. We can compare the distributions of percentile ranks of SAT scores over time for new teachers entering the workforce the year after receiving their bachelor's degree (beginning teaching in the 1993–94, 2000–01, and 2008–09 school years) to those of other college graduates in the same cohort working full time the year following graduation. We find that more academically competent individuals are being drawn into the teaching profession. There is a small drop in average SAT percentile rankings for teachers between 1993 and 2000, from 45 to 42 (the raw SAT scores are similar for teachers in the 1993 and 2000 cohorts, but scores for nonteachers were higher for the 2000 cohort, resulting in a decrease in the average percentile rank for teachers). There is a sizable jump up in teachers' average percentile rank to 50 for the 2008 cohort (see Figure 1), driven mainly by the proportion of teachers with SAT scores that fall in the top quartile of the distribution. This finding of increasing academic competence for newer entrants to the teacher labor market also shows up when we use undergraduate GPA as our indicator of academic competency, though research by Cory Koedel indicates that inconsistent grading standards across academic majors may render this measure less meaningful.

Next we examine the academic competence of teachers and nonteachers by college major. Examining the data at this level of detail is worthwhile for three reasons. First, an individual's college major has important implications for compensation. Because teacher salaries are typically not differentiated by area of training, and the economic returns to math and science degrees have increased over time, it is more likely that graduates trained in those high-demand fields have opportunities for higher pay in other careers. Second, and consistent with the first point, there is considerable evidence that school systems find it more challenging to hire and retain teachers in science, technology, engineering, and mathematics (STEM) areas. Third, teacher majors tend to be related to the courses they are teaching, which is consistent with the notion that strong content knowledge is one of the attributes of teacher success. In fact, the overwhelming majority (about 95 percent) of the newly minted STEM majors in each cohort who enter the teaching profession teach in math or science classrooms (i.e., nonelementary and including math, biology/life

### SAT Performance On the Rise (Figure 1)

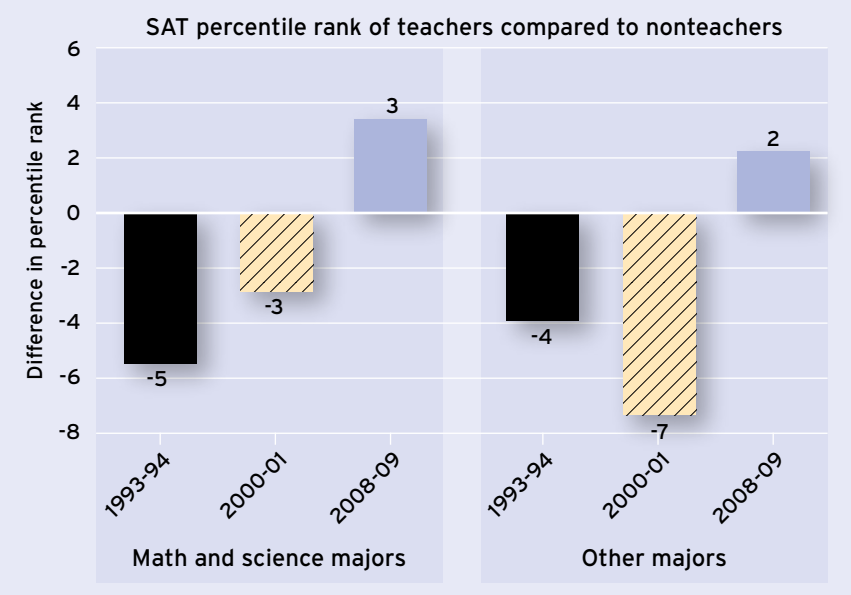
*Average SAT performance of first-year teachers rose by 5 percentile rank points between the 1993-94 and 2008-09 school years.*




**SOURCE:** Authors' calculations using data from the Baccalaureate and Beyond Longitudinal Study

## Test-Score Gap Reversal (Figure 2)

*Regardless of college major, graduates in the class of 2008 who became teachers the following year performed better than nonteachers on the SAT test.*




**NOTE:** Math and science majors include engineering and technology.

**SOURCE:** Authors' calculations using data from the Baccalaureate and Beyond Longitudinal Study

science, chemistry, geology/earth/space science, physics, computer science, or general science). Despite this, when we look at either new teachers (using the B&B) or all teachers (using the SASS), we find that many of these classrooms are not staffed by teachers with a STEM major. Among new teachers leading math or science classes in 1993-94, 31 percent had STEM degrees, 20 percent did in 2000-01, and in 2008-09, 30 percent had majored in one of those subjects.

It is not surprising that the academic caliber of teachers varies a good deal by subject area, given that STEM majors tend to have higher SAT scores than non-STEM majors. For all three cohorts, STEM majors' SAT score average is about 100 points higher in each year than that of non-STEM majors, and a far higher proportion come from the top 20 percent of the distribution. For both the 1993 and 2000 cohorts, teachers score lower on average than nonteachers among both STEM majors and non-STEM majors, in some cases by as much as 7 SAT percentile rank points (see Figure 2). However, in the case of the 2008 cohort, scores for teachers were slightly *higher* for both STEM majors (by about 3 percentile rank points) and non-STEM majors (by about 2 percentile rank points) than for nonteachers. In other words, we find that high-scoring STEM majors are relatively more likely to become teachers in 2008 than they were in earlier cohorts. There is still considerable overlap in the distributions of scores for teachers and nonteachers in both groups, but the gap in the academic proficiency of teachers and graduates entering other professions had clearly narrowed a great deal—and even reversed—by 2008. Particularly notable is the fact that there has been a sharp decline in the share of STEM majors entering teaching from the bottom 20 percent of the SAT distribution, which fell from 13 percent in 1993 to less than 2 percent in 2008.

What explains the seeming dichotomy between what we see when we look at trends for prospective teachers (based on college major) and trends for those who actually enter the teacher workforce? One possibility is that there are within-college shifts in who opts to teach; these would not be captured by the college selectivity measures but would show up in the individual-level analysis. Another possibility is that many individuals who graduate from college with an education major do not actually end up teaching, and it may be that the more academically competent among those trained to teach actually become teachers, either because of application or hiring decisions. To shed light on these issues, we take a more detailed look at who progresses through college into the teaching profession.

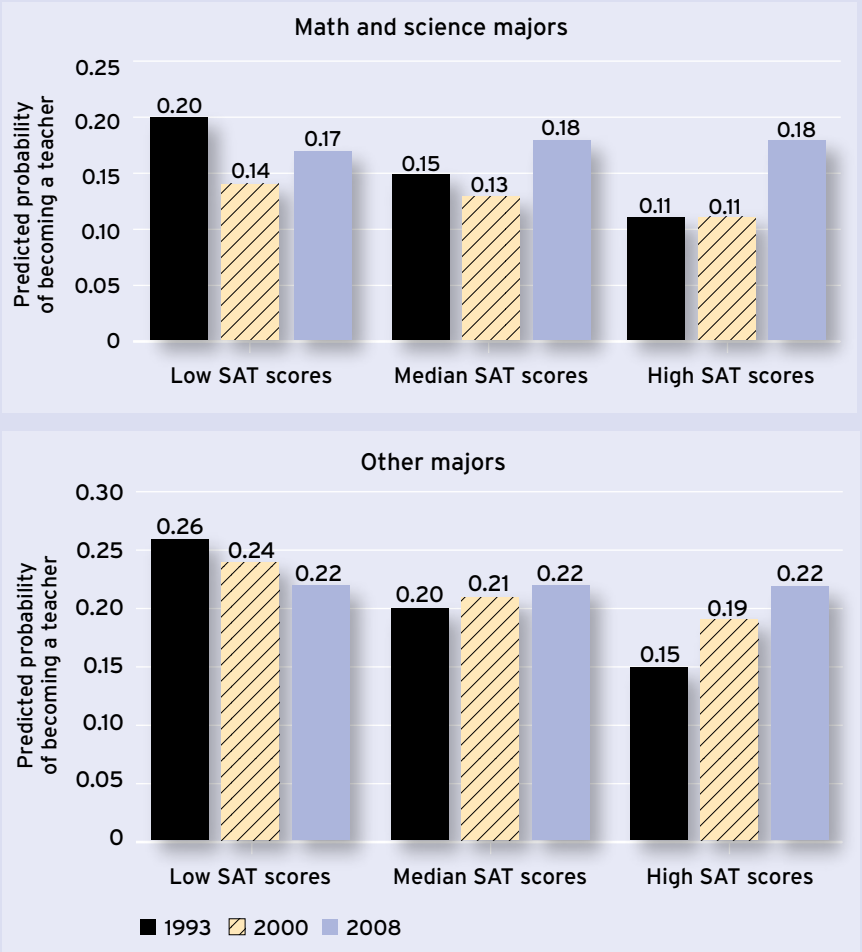
STEM majors' SAT score average is about 100 points higher in each year than that of non-STEM majors.

## Applying and Getting Hired to Teach

Our final analysis uses data from the B&B to examine whether measures of individuals' academic competence and college training are predictive of whether they 1) apply for a teaching position, and 2) end up in the teacher workforce in the year following graduation. To keep things simple, we focus on the decisions of female graduates who are employed full time in the year following graduation. We do this because men

## High Performers More Likely to Teach (Figure 3)

*Those with high SAT scores were more likely to pursue a teaching position in 2008 compared to earlier years, while those with low SAT scores were less likely to do so in 2008 than in the past.*




**NOTES:** Math and science majors include engineering and technology. High SAT scores are those at the 90th percentile, median SAT scores are at the 50th percentile, and low SAT scores are at the 10th percentile. Displayed probabilities are for white, female graduates who are employed full-time in the year following graduation.

**SOURCE:** Authors' calculations

and women exhibit different labor-market behavior and because women make up approximately three-quarters of the teacher workforce.

For each cohort, STEM majors are about 4 to 8 percentage points less likely to apply for a teaching job than non-STEM majors. In the first two cohorts, we find that graduates with higher SAT scores are generally less likely to pursue a teaching career, but this is not the case in 2008. Specifically, in 1993, the probability of applying for a teaching job decreases as SAT score increases, with a difference of about 10 percentage points between a teacher at the 20th percentile and a teacher at the 80th percentile on the SAT distribution. A similar pattern exists in 2000, but the negative relationship between SAT scores and the propensity to apply for a teaching job is not as strong. By 2008, there is no relationship between college graduates' SAT scores and their likelihood of applying to teach, when controlling for the other variables in the model (college major, undergraduate GPA, college selectivity, parents' occupation, parental income, and race/ethnicity). Put another way: individuals with high SAT scores from earlier cohorts were less likely to pursue a teaching position than their lower-scoring counterparts, but for the 2008 cohort, high- and low-scoring individuals were about equally likely to pursue a teaching job.

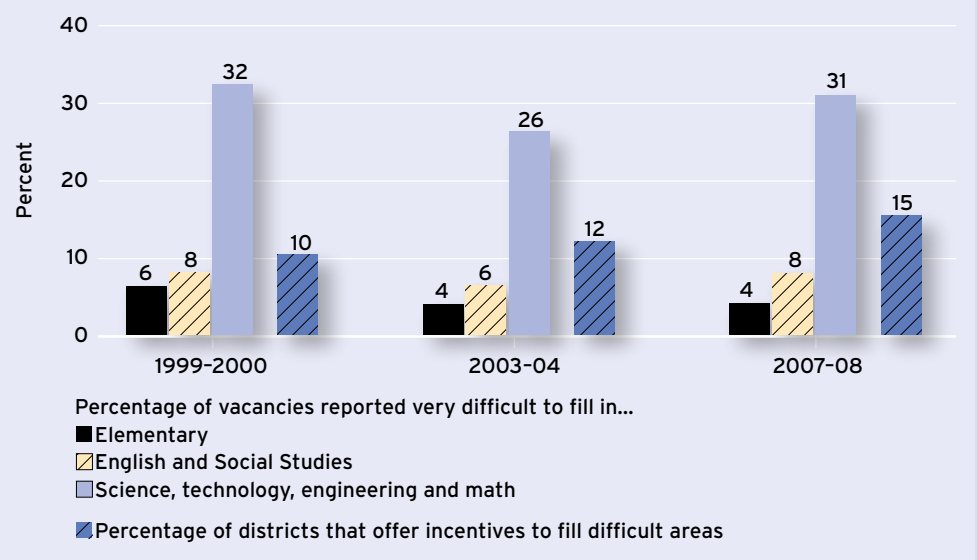
We also investigate whether there have been changes over time in both the relative probability for STEM and non-STEM majors to enter the teaching profession and the relationship between SAT scores and the likelihood of employment. To illustrate this, Figure 3 reports the probability of being employed as a teacher in the year following graduation for a "typical" white, female STEM graduate and a similar non-STEM graduate with SAT scores at the 10th, 50th, and 90th percentiles. Because entering the teacher workforce is a function of whether an individual applies for a position and the hiring decisions of districts, these results show the effect of academic competency on the likelihood of applying and getting hired contingent on applying. In all years, STEM majors are less likely than non-STEM majors to enter teaching, although this difference is statistically significant only in 2000. In 1993 and 2000, the likelihood of entering teaching decreases as SAT scores increase, while in 2008 there is no relationship between SAT scores and the propensity to become a teacher.

And what of the concern that test-based accountability policies are making teaching less attractive to talented individuals? To evaluate this claim, we compare the SAT percentile ranks across the three B&B cohorts of new teachers entering classrooms that typically face pressure to achieve high test scores (grade 4–8 reading and math) and classrooms that do not involve high-stakes testing. We find that new teachers in high-stakes

classrooms tend to have higher SAT scores than those in other classrooms, and that the differential in teachers' SAT scores between the two classroom types grew by about 6 SAT percentile points between 1993 and 2008. Test-based accountability greatly increased after the 2001 passage of NCLB, but we see no evidence that more academically proficient teachers entering the workforce in the year immediately following graduation are shying away from (or at least are not being assigned to) high-stakes classrooms.

## Math and Science Teachers Wanted (Figure 4)

*Schools report greater difficulty filling teaching positions in math and science than in other areas even though an increasing number of districts offer pay incentives in areas that are difficult to staff.*




**SOURCE:** Authors' calculations using data from the Schools and Staffing Survey

## Conclusions

In summary, although teachers in the U.S. are more likely to be drawn from the lower end of the academic achievement distribution than are teachers in selected high-performing countries, the picture is a bit more nuanced than the rhetoric suggests, and as we illustrate, it has in fact changed over time in an encouraging direction. There was an upward shift in achievement for 2008 college graduates entering the teacher workforce the following school year. In fact, 2008 graduates both with and without STEM majors who entered the teacher workforce had higher average SAT scores than their peers who entered other occupations.

What explains the apparent rise in academic competency among new teachers? As we show, the SAT scores of those seeking and finding employment in a teaching job differ in different years. It is possible that alternative pathways into the teaching profession have become an important source of academic talent for the profession. Unfortunately, we cannot explore this issue in any depth because the way in which teachers were asked about their preparation has varied over time. Regardless, alternative routes are unlikely to be the primary explanation for the changing SAT trends given that, with a few high-profile exceptions like Teach for America, alternative certification programs are not highly selective.

Differences in the labor market context across years may help explain the rise in SAT scores. According to data from the Bureau of Labor Statistics, the average unemployment rate in 2009 was about 9 percent to about 6 and 5 percent in 1994 and 2001, respectively. The high unemployment rate in 2009 may have led more high-scoring graduates to choose to pursue comparatively stable and secure teaching jobs rather than occupations that were viewed as riskier in the economic downturn. By contrast, those graduating in 2000 were entering the labor market during the tech boom, when there was a good deal of competition for the labor of prospective teachers. Regardless of the reason for the changes in academic proficiency that we observe, however, the data are encouraging and *may* represent the reversal of the long-term trend of declining academic talent entering teaching.

Finally, we see little change across years in the relative propensity of STEM and non-STEM majors to become teachers. There has been a gradual increase over the past decade in the percentage of districts offering pay incentives for shortage areas (see Figure 4), but recent evidence (see work by Katharine Strunk with Jason Grissom, Tammy Kolbe, and Dara Zeehandelaar) shows that few districts are truly strategic in matching incentives to staffing needs, and as a consequence, school systems continue to struggle to fill teaching slots in math and science. It appears that education policies related to both compensation and working conditions must evolve further if school systems are to address the challenge of staffing math and science classrooms with teachers of strong academic caliber.

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