B. Compensation for Teachers of Hard-to-Fill Subjects and Teachers in Hard-to-Staff Schools

How much would salaries have to increase to attract and retain sufficient numbers of mathematics and science teachers, whose specialized skills and knowledge generally command much higher salaries in the private sector?

It is widely believed that low teacher salaries contribute to widespread shortages of mathematics and science teachers and that higher salaries would improve both recruitment and retention of teachers of these hard-to-fill subjects. Contrary to popular wisdom, a few studies have found that mathematics and science teachers are not more likely to leave the profession than teachers of other subjects, though they are more likely to switch schools (Imazeki, 2005; Ingersoll, 2000, 2001). In addition, some prior research found that biology, chemistry, and physics teachers had some of the highest rates of attrition, but surprisingly, mathematics teachers had some of the lowest (Grissmer & Kirby, 1992; Murnane, Singer, Willett, Kemple, & Olsen, 1991).

Other studies suggest, however, that attrition rates of mathematics and science teachers are significantly higher than attrition rates of teachers in other fields (Henke & Zahn, 2001; Kirby, Naftel, & Berends, 1999; Podgursky, Monroe, & Watson, 2004). Importantly, Podgursky et al. (2004), found that not only were high-ability mathematics and science teachers more likely to exit the profession than teachers of other subjects, but female mathematics and science teachers were also much less sensitive to small increases in pay. In contrast, pay increases had the largest effect on turnover among female elementary school teachers. According to the researchers, these results suggest that small across-the-board pay raises that reward all teachers equally without regard to subject specialization would disproportionately reduce turnover among elementary teachers, who are not in short supply, but would have little effect on mathematics and science teachers. Substantially larger pay increases would be necessary to retain high-ability teachers in these hard-to-staff subject areas.

Other studies also suggest that concerns about low salaries do, in fact, influence individuals' decisions to become mathematics and science teachers as well as decisions to leave the profession (Hounshell & Griffin, 1989; Rumberger, 1987). Freshmen surveyed at one engineering school in the Midwest—even those identified as being "teaching-oriented"—cited low salaries as the primary reason for not becoming teachers (Evans, 1987). Milanowski (2003), too, found that low pay was most frequently mentioned by focus groups of undergraduate mathematics, science, and technology majors as the reason they were not interested in pursuing a teaching career.

In fact, the differential between teacher salaries and private sector salaries is much larger for mathematics and science teachers than it is for teachers in other fields. Analyses of 2001 and 2002 salary comparisons compiled by the National Education Association revealed that median annual salary offers to education majors were $10,000 to $20,000 less than median offers to students who majored in mathematics, accounting, engineering, and some sciences (see Milanowski, 2003).

Using data from the cohort of 1993 college graduates in the national Baccalaureate and Beyond Longitudinal Study, Goldhaber, DeArmong, Liu, and Player (2007) developed statistical simulations to estimate the salaries that individuals with different types of technical skills and training would likely earn inside and outside of the teacher labor market. Their simulations indicate that graduates with technical degrees from selective colleges may actually earn more in the teacher labor market than in the private sector at the outset of their careers. The salaries offered by the private sector, however, quickly surpass salaries for public school mathematics and science teachers in a few years, and the earnings gap continues to widen as teachers progress in their careers. Goldhaber et al. estimated that, in 1994, a nonteacher with a technical degree (in engineering, biological or other science, or mathematics) would have earned more than $4,000 more than an individual with a technical degree who chose to become a teacher. By 1997, the difference in earnings would have been more than $16,000, and by 2003, the difference would have been nearly $24,000. The researchers found similar patterns when they examined teachers' projected earnings by individual SAT scores and the selectivity of the college they had attended. After about 10 years in the labor force, a female graduate of a selective college with a technical degree who became a teacher would be earning more than $8,000 less, or 18 percent of her salary, than she would have earned if she had been working in the private sector. The earnings gaps for men are even higher. These differentials, they contend, explain why many highly skilled college graduates with science, technology, engineering, and mathematics (STEM) training are disinclined to teach.

Because low salaries do appear to deter many STEM majors from entering Grades K–12 teaching, an important question for policymakers is just how much salaries would have to increase to make teaching more attractive to individuals with mathematics and science backgrounds. One way to answer this question, as Goldhaber (2006) did, was to examine how much individuals with and without technical majors command outside of the teacher labor market. The difference, based on analyses of the Baccalaureate and Beyond dataset, is about $11,000 a year. Goldhaber notes that this is considerably higher than some of the relatively small recruitment bonuses of several thousand dollars that school districts have typically offered to teachers of hard-to-fill subjects in the past (see Prince, 2003).

In recent years, however, a number of states and districts have started offering prospective mathematics and science teachers much larger cash bonuses, tuition incentives, or housing incentives in the neighborhood of $10,000 to $15,000, though many of these incentives are still one-time bonuses (see Prince, 2007). Several examples follow:

- Guilford County, North Carolina, offers a one-time bonus of $10,000, a laptop computer, and up to $4,000 annually in performance pay to highly qualified mathematics teachers who agree to work in the district's highest need Mission Possible high schools.
- In 2006, three other North Carolina districts received funds from the state board of education that enabled them to offer $15,000 signing bonuses to middle school and high school teachers certified in mathematics or science.
- That same year, the University of Tennessee-Battelle Memorial Institute assisted two rural districts in East Tennessee, so that they could offer $10,000 recruitment bonuses to highly qualified mathematics and science teachers, on the condition that they remained in the districts for at least three years.
- In Los Angeles, newly assigned, fully credentialed mathematics, science, and special education teachers who agree to work in designated low-performing schools are eligible for a $5,000 recruitment bonus, an additional $5,000 retention bonus if they remain in a target school for three years, and up to $5,000 in educational expenses toward a master's degree. The district will also cover up to $5,000 in educational expenses to help other teachers in the target schools become fully credentialed in mathematics, science, or special education.
- In New York City, certified mathematics and science teachers can earn up to $15,000 in housing incentives by working in one of the city's lowest performing middle schools or high schools for at least three years. Special education teachers of any grade are also eligible for the same housing incentives.
- In Virginia, experienced mathematics teachers selected to participate in the state's Middle School Teacher Corps can earn up to $30,000 in additional pay over three years by transferring to one of the state's lowest performing middle schools and fulfilling a three-year commitment to teach and possibly to mentor other teachers.

The issue of how big incentives need to be in order to be effective is far from resolved, however, and more evaluations of program effects are needed to help policymakers formulate effective compensation policies. A rare example of such a study was conducted by Clotfelter, Glennie, Ladd, and Vigdor (2006), who evaluated the effects of a teacher retention incentive offered to certified mathematics, science, and special education teachers in high-need schools in North Carolina. Although other research suggests that incentives must be fairly large to retain mathematics and science teachers, particularly in hard-to-staff schools, Clotfelter et al. estimated that a relatively small annual bonus of $1,800 was sufficient to reduce teacher turnover by 12 percent.

Using a different approach to estimate how much salaries would have to increase to expand the supply of mathematics and science teachers, Milanowski (2003) conducted a survey of undergraduate majors and premajors in science, mathematics, and technology to determine the salary levels and other working conditions that would be needed to attract them to careers in Grades K–12 teaching. Roughly 200 sophomores and juniors from one large, midwestern university participated in the study. Milanowski found that an increase in entry-level salaries of about 25 percent would be needed to motivate about 20 percent of the respondents to consider becoming a teacher.

He also noted, however, that there is a limit to how effective salary increases would be as a strategy to expand the pool of potential mathematics and science teachers. Not all of the students with the skills to become mathematics and science teachers reported that they would likely change their career paths, even if offered a substantial increase in pay because expectations about job demands, personal interests, and abilities also influenced students' career choices.

Another important finding was that the size of the salary increase that would be needed to motivate a STEM major to consider becoming a teacher depended on the student's major and the salary that the student expected to earn in his or her current choice of occupation. For example, greater increases were needed to attract engineering students than students in pure and applied sciences because of the higher salaries that engineering students expected to earn. Consequently, teacher recruitment strategies aimed at engineers and engineering students would not be efficient because the salary needed to attract them would probably be unrealistic for most school districts.

Milanowski emphasizes that this does not mean that entry-level salaries for mathematics and science teachers need to be raised as high as the salaries offered in engineering, computer science, and higher paid health occupations to attract some of these individuals. However, they would have to be raised more than 5 percent to10 percent to attract a substantial proportion of them.

Goldhaber et al.'s analyses suggest that incentives of several thousand dollars that have been typically offered to teachers of hard-to-fill subjects are not big enough to be effective.

Differential pay in the range of $10,000 to $15,000 may be more in line with what is needed to make teaching a more attractive career choice for individuals with STEM backgrounds, but this issue is not yet resolved. Importantly, Goldhaber et al. stress that comparing only entry-level salaries of teachers and nonteachers may present misleading findings as to what it will take to make mathematics and science teaching more attractive financially because the differences are not large at the outset. However, individuals with technical backgrounds who choose to become teachers make far greater financial sacrifices to teach than others. Those designing new compensation systems should also consider the size of the earnings gap between teachers and nonteachers with technical backgrounds over time.

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