How will baby boomer retirements affect teacher labor markets?

Daniel Aaronson and Katherine Meckel

Introduction and summary

Teachers play a vital role in their students' educational performance. In addition, there is a correlation between a teacher's experience and her effectiveness in the classroom—at least in the first few years of her career. These intuitive outcomes are supported by a large body of research literature.[1] With this in mind, it is reasonable to view rising rates of teacher turnover (since the early 1990s) as a cause for concern. Further, we expect that retirements, which have driven some of this increase, will accelerate to record levels in the coming decade as growing numbers of baby boomers reach retirement age.[2] This pattern will inevitably necessitate a significant increase in the demand for new teachers. Some communities—for example, poor urban districts, which tend to have especially high teacher turnover rates and severe recruitment problems[3]—might be particularly susceptible to declining teacher quality as a result of increased retirements.

In this article, we use a simple model of teacher demand and supply in order to gauge the implications of baby boomer retirements on the projected demand for new teachers. Our forecast links estimates of demand for all teachers with the expected supply of returning teachers through 2020 (that is, the 2020–21 school year). We assume any shortfall would have to be addressed by hiring additional teachers. We discuss how projected demand for new teachers compares with the past half century and what types of schools are likely to have to augment their teacher hiring over the coming decade. We also calculate how much teacher salaries would have to increase in order to fill the gap between teacher supply and demand. To compute the supply and demand of the teacher market, we use a variety of data sets and sources—for example, the U.S. Census Bureau's *Decennial Census* and *Current Population Survey* (CPS) and various publications of the U.S. Department of Education's National Center for Education Statistics (NCES), including its 2003–04 *Schools and Staffing Survey* (SASS) and the accompanying 2004–05 *Teacher Follow-up Survey* (TFS).

We estimate the number of new full-time public school teachers[4] needed from 2009 through 2020 will be between 2.3 million and 4.5 million, with the range encompassing reasonable assumptions about fertility rates, student–teacher ratios, and turnover propensity. Our preferred calculations—based partly on the latest teacher data available from the 2003–04 school year (and therefore not accounting for the economic downturn that began in late 2007)—predict roughly 277,000 new full-time public school teachers needed in 2009–10, rising to 303,000 new teachers by 2020–21, or 3.5 million for all school years between 2009–10 and 2020–21. Retirements account for about one-third of the teachers who leave the teaching work force over this period. Adding the private school sector to these calculations raises the number of new teachers needed by about 20 percent, to 4.2 million, but lowers the fraction due to retirements by roughly 3 percentage points.

These numbers, in isolation, are difficult to assess without some historical context. Therefore, we provide rough estimates of projected demand for new teachers over the past six decades using U.S. *Decennial Censuses*, combined with analogous hiring projections for the years 2010 and 2020. We find that more teachers will retire between 2010 and 2020 than in any other decade since the end of World War II. But because of relatively slower projected growth in the school-age population, the total number of new teachers needed for all reasons (including retirements) is within historical norms. Indeed, normalized by the size of the aggregate labor

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force (one rough measure of the potential teacher work force), demand for new teachers will be similar in magnitude in the coming decade to that in past decades. Therefore, we would not expect the increase in forthcoming retirements, *in the aggregate*, to have a significant impact on national levels of teacher hiring much beyond the variation in teacher hiring needed in the past.

However, it is still possible that certain areas will be especially hard hit by teacher retirements. Therefore, we explore how demand for new teachers is likely to vary based on a school's regional location, urban or rural status, share of free or reduced price school lunch recipients, and racial composition. We find that the need for new teachers is likely to be notably elevated in schools with a high fraction of minority or low-income students. However, this is not driven by an abnormal number of upcoming retirements in these schools, but rather by a combination of elevated teacher turnover rates and expected student population growth. For example, schools with minority representation in the top quartile of the distribution are expected to require 65 percent more new teachers than schools with average minority representation, but only 4 percent of this *difference* is due to retirements.

It is important to emphasize that our estimates are based on a mechanical model of teacher labor markets that assumes some key factors related to the propensity to enter and exit the teaching profession—such as compensation, pension packages, certification requirements, and tenure decisions—will look like they have in the recent past.[5] Difficulty in hiring or retaining teachers could lead local communities to change policies in a way that influences the supply of available teachers. However, many communities, especially those that face the most significant change in hiring over the coming decade, could find making the necessary policy changes challenging. To quantify this difficulty, we provide a very simple calculation of how compensation would have to change in order to offset elevated hiring requirements and keep teacher quality relatively stable; this exercise assumes that salary adjustment is the sole tool schools use to satisfy their growing demand for teachers. We find that real salaries would have to rise by an additional 10 percent beyond historical averages between 2009 and 2020. Pay would have to be particularly bolstered in heavily poor and minority schools in order to offset their expected demand for new teachers over the coming decade.

This article is organized as follows. In the next section, we explain our algorithm for projecting the demand for new teachers in the coming decade. Then we describe the results and provide some historical context by comparing our projections with similar estimates from the past half century. We also explore how our estimates differ by various school characteristics. Next, we ask how compensation policy might have to be adjusted, given estimates of the labor supply elasticity of teachers, to account for any additional hiring requirements in the future. We acknowledge that our data do not cover the period since the current economic downturn began; therefore, we briefly explore some channels in which the current recession might affect short- and long-run demand for new teachers.

A mechanical model of demand for new teachers

In this section, we describe the algorithm we use to forecast demand for new teachers.[6] To provide further intuition for our methodology, we also present a very simple numerical example in the accompanying box that, for expository reasons, strips the model to its bare minimum. Similar models are presented in Hussar (1999).

Demand for teachers

We estimate future demand for teachers by projecting student enrollment through 2020 (that is, the 2020–21 school year). Student enrollment is forecasted based on projections of the five-year-old population, estimates of the propensity to attend public school kindergarten, and estimates of grade progression rates. We then apply a student–teacher ratio to get the total number of teachers needed to fill classrooms to accommodate these students.

We begin with a baseline of the most recent count of students, broken down by grade, compiled by the National Center for Education Statistics for the 2003–04 school year. Each of these students is assumed to advance through the public school system based on estimated grade-specific progression rates calculated by the NCES for the 1999–2000 school year through the 2002–03 school year and displayed in table 1.[7]

New cohorts are added each year to kindergarten based on U.S. Census projections of five year olds corresponding to that school year[8] and the average fraction of five year olds that have attended public school kindergarten in the recent past. Since the mid-1980s, the share of five year olds attending public school kindergarten has varied a bit over time, but not in a way that suggests a trend.[9] Therefore, we project forward using 0.878, which is the average share of five year olds who attend public school between 1999 and 2003, the last four years for which data are available.

To get a final count of classrooms, we apply student–teacher ratios to our student totals based partly on forecasts from table 33 of Hussar and Bailey (2007), which include high, middle, and low scenarios. In the

BOX 1

A very simple numerical illustration

Assume that there are five types of teachers in time t (that is, $T_{1t}, \ldots, T_{5t}$) distinguished solely by their age. Age determines turnover propensity. For example, the youngest group, T_{1t}, exits with probability $p_{1.} = 0.2$ in every year; groups T_{2t}, T_{3t}, and T_{4t} exit with probability $p_{2.} = p_{3.} = p_{4.} = 0.1$; and the oldest group T_{5t} leaves with probability $p_{5.} = 0.5$. We simplify the example by assuming that all teachers work full time and are of the same gender and that experience, tenure, and age are perfectly collinear; but in the article, probabilities for various transitions, including exits, are estimated by age, experience, tenure, and gender (see table 2, p. 7). Further, assume there are 1,000 teachers in the initial year ($t = 1$), split evenly across the age groups. At the end of that initial year, total turnover $Exit_{.1} = \sum_{i=1}^{5} T_{i1} \times p_{i.} = 200 \times 0.2 + 200 \times 3 \times 0.1 + 200 \times 0.5 = 200$, where $i = 1$ to 5 is the age group. The overall turnover rate is 200/1000 = 0.2.

Further, assume that the demand for teachers grows by 1 percent per year because of changes in student–teacher ratios and growth in the new kindergarten cohorts. We abstract from issues related to grade progression rates for simplicity. Prior to the second year, the teacher work force must therefore expand by $Expand_{.1} = \Sigma T_{i1} \times 0.01 = 1000 \times 0.01 = 10$ *teachers*.

Together, this implies that *Demand for New Teachers*$_{.1}$ = $Exit_{.1} + Expand_{.1} = 210$, the number of teachers that must be hired prior to the second year.

These 210 new teachers are assumed to have certain characteristics estimated from earlier cohorts of new teachers. To keep the example simple, assume that half the new teachers fall in age group 1 ($z_{1.} = 0.5$) and the other half in age group 2 ($z_{2.} = 0.5$). Therefore, we add 105 teachers to T_{12} and T_{22}. Note, that in our simulations, all returning teachers are made older by a year between the first and second years. We abstract from that in this example, but it would imply that teachers would move between age types each year.

In the second year, the new distribution of teachers for group i is: $T_{i2} = T_{i1} \times (1 - p_i) + Exit_{.1} \times z_{i.} + Expand_{.1} \times 0.01 \times z_{i.}$. The first term is the number of returning teachers of type i, the second term is the number of new teachers of type i replacing any who exit, and the third term is the number of new teachers of type i hired because of expansions in the teacher work force. So, for example, the number of young teachers in the second year is $T_{12} = 200 \times (1 - 0.2) + 200 \times 0.5 + 1000 \times 0.01 \times 0.5 = 265$. Once we have a new distribution of teacher types, we again apply turnover propensities, add in growth to demand, and then compute the number of new teachers needed prior to the third year. This algorithm continues through the forecast horizon.

middle scenario, student–teacher ratios in public schools decline by roughly 1.2 students per teacher between 2004 and 2016. However, because of concern that these trend projections overweight the substantial decline in student–teacher ratios seen in the 1990s, our baseline assumption uses the average of the high scenario and a flat student–teacher ratio. Empirically, this is roughly equivalent to using the average decline between the school years 1999–2000 and 2003–04, the most recent years of data available.[10]

Figure 1 summarizes the projected demand for public school teachers. The solid line provides our best guess estimate, with the shaded range allowing for plausible deviations for the student–teacher ratio and the population growth rate of five year olds, as explained previously.

Supply of teachers

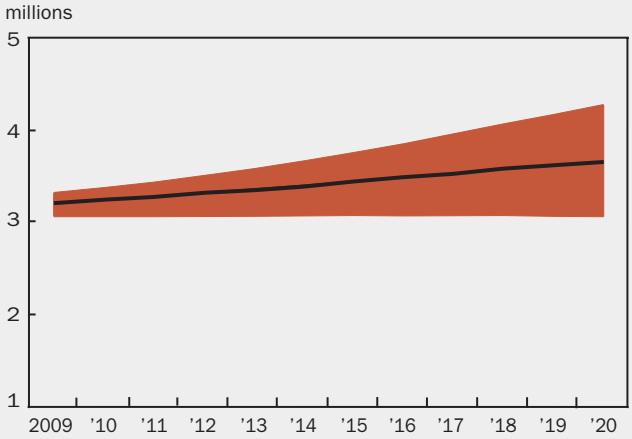
To project the supply of teachers, we begin again with the latest detailed accounting of market size—this time taken from the 2003–04 SASS. That survey tells us there were just over 3 million full-time public school teachers.[11] From the 2004–05 TFS, we can compute that 7.8 percent left public school teaching the following year. An additional 89.6 percent continued as full-time teachers and 2.6 percent as part-time teachers. Note that the latter two rates encompass teachers who switch their work time commitment (full-time versus part-time positions), as well as those who keep the same work time commitment as the previous year.

But all of these rates differ substantially by age, gender, experience, and tenure in the current job.[12] Examples of this heterogeneity are displayed in figures 2's panels A and B, which show how rates of exiting the teaching profession and staying as full-time or part-time teachers differ by age and gender. For example, not surprisingly, exit rates rise monotonically after age 50, and part-time status appears to be higher among women throughout most of the age distribution.

To compute future changes in teacher hours, we simulate the fraction of hours that are likely to return each year by using a simple ordered probit model that allows for three possible transitions—exit, full-time to part-time, and part-time to full-time—and accounts for differences by age, gender, experience, and tenure.

FIGURE 1

Projected demand for public school teachers, 2009–20



Notes: The solid line is our preferred forecast. The shaded region encompasses the plausible range of estimates. Demand for public school teachers was estimated for 2004–08 (not shown), since actual hiring data for those years are not available, and then carried through 2020. See the text for details.

Sources: Authors' calculations based on data from the U.S. Census Bureau, population estimates and projections; U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003–04 *Schools and Staffing Survey* and compilation of yearly national student counts by grade and type of school, 1999–2003; and Hussar and Bailey (2007), table 33.

Table 2 reports the results of our baseline regression. We use the coefficient estimates from this regression to assign an end-of-school-year outcome for all individuals in the 2003–04 cohort based on their personal characteristics. This computation provides us with a forecast of the number of returning teacher hours in 2004–05. We then add a year to each returning teacher's age, experience, and tenure. We continue to project this cohort through the forecast horizon (2020–21), using the same procedures (appropriately adding a year to each returning teacher's age, experience, and tenure).

Three points about the simulations thus far are worth noting. First, it is well known that exits are especially high in the first few years of teaching. That pattern is clearly evident in figure 2, panel A, which displays the hump in exits for women in their late twenties and early thirties. A similar pattern exists when exits are plotted against tenure or experience. We include a dummy for the first five years of experience to account for this nonlinearity.

Second, because of data limitations, tenure is measured as *consecutive* years as a public school teacher, whereas experience is measured as the total number of years as a public school teacher. Unsurprisingly, our results are nearly identical if we exclude the tenure measure.

Third, we do not focus solely on exits because transitions between part-time and full-time teaching positions clearly affect changes in the total number of teacher hours. Specifically, figure 3 (p. 8) shows that part of the growth in teacher hours between 2003–04 and 2004–05 arises from a larger fraction of teachers switching from part-time to full-time positions than vice versa. The exit rate alone is, on average, 7.8 percent; however, accounting for changes in hours from switches between part-time and full-time positions effectively lowers the overall hours turnover rate to 6.5 percent.[13]

To this point, we have described how we project staffing levels due to the work choices of the existing cohort of 2003–04 teachers. But, each year, demand for classrooms exceeds the number of returning teachers; therefore, new instructors must be added to account for those hours. In the simulation, this deficit is filled by adding the appropriate number of "missing" hours to the model each year, while assigning them the age, gender, experience, tenure, and part-time/full-time status that replicates the distribution of characteristics of new teachers in the most

TABLE 1

Average public school grade progression rates

	Progression rate
Kindergarten to 1st grade	1.064
1st to 2nd grade	0.987
2nd to 3rd grade	1.008
3rd to 4th grade	1.003
4th to 5th grade	1.004
5th to 6th grade	1.016
6th to 7th grade	1.015
7th to 8th grade	0.997
8th to 9th grade	1.133
9th to 10th grade	0.892
10th to 11th grade	0.910
11th to 12th grade	0.934

Note: A number above 1 implies a net influx of students coming into public schools in that particular grade from either private schools or schools without grade levels or home schooling; or it implies an influx of children entering the U.S. school system for the first time (recent immigrants).

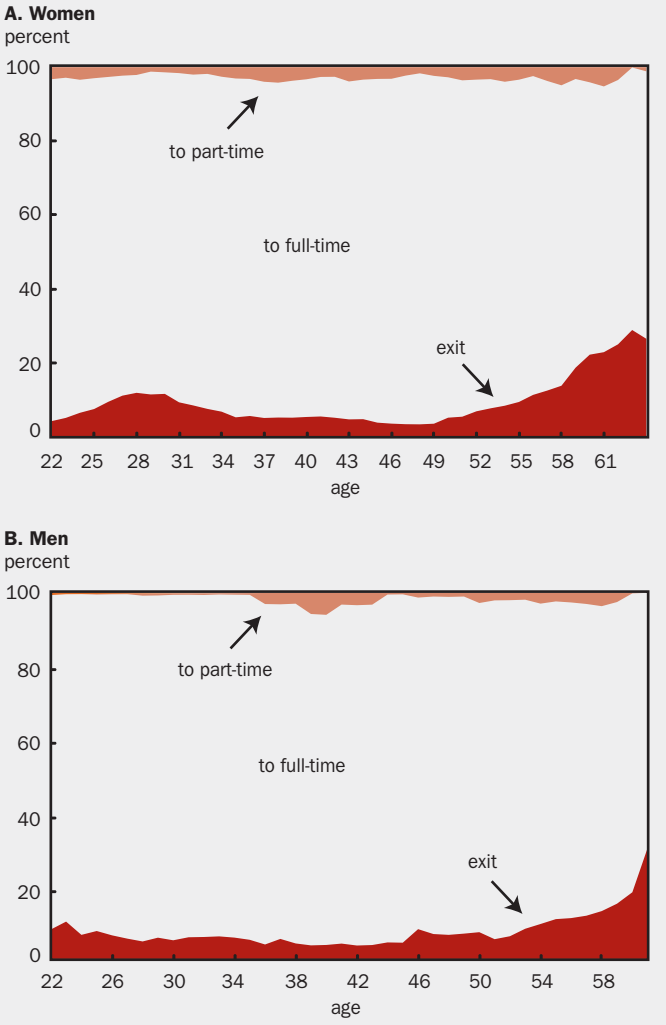
Source: Authors' calculations based on data from the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, compilation of yearly national student counts by grade and type of school, 1999–2003.

recent SASS.[14] We then update all of the returning teacher characteristics by making them older an additional year (and giving them an additional year of total work experience and tenure) and rerun the simulations to the following year, using the transition probabilities inferred from table 2. We continue this algorithm through the 2020–21 school year, continuously replacing missing teacher hours with representative entrants and updating the tenure, total experience, and part-time/full-time status of those remaining. This methodology assumes that schools will continue to hire teachers from the same demographic (that is, gender, age, experience, and tenure) background as they have in the recent past and that the part-time and full-time fractions by age and gender stay constant.[15]

We can ascertain the importance of teacher retirements in two ways. First, the follow-up survey asks the reason why teachers exit the profession. Retirement is listed as the reason for roughly 32 percent of all exits at the end of the 2003–04 school year, including 70 percent or higher among exits of teachers aged 55 and older. However, our prediction methods cannot distinguish between reasons for exiting the teaching profession. Therefore, we compute the probability a future exit is due to retirement based on the actual gender and age exit rates displayed in panels A and B of figure 2 and their correlation with the reason for exit in the 2003–04 SASS. Exits rise by 1.2 percentage points, on average, per year for ages 50–60, with overall turnover rates hitting close to 30 percent shortly after age 60. Note that turnover is also high among young and inexperienced teachers, especially women, who represent the bulk of the new teachers. Again, because we tend to exchange exiting teachers with these high-turnover replacements, retirements further amplify demand for new teachers by temporarily introducing high-turnover employees into the system.

FIGURE 2

Teacher transition rates, by age



Notes: The transition rates are computed as five-year weighted moving averages. To full-time and to part-time rates encompass teachers who switch their work time commitment as well as those who keep the same work time commitment as the previous year.

Sources: Authors' calculations based on data from the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003–04 *Schools and Staffing Survey* and 2004–05 *Teacher Follow-up Survey*.

Demand for new teachers

Lastly, for each year, we compare returning teacher supply (that is, how many teachers are left from the 2003–04 cohort and each subsequent cohort of new teachers) with demand. The additional teachers needed to fill the gap between supply and demand are what we call the demand for new teachers.

Basic estimates of demand for new teachers

Figure 4 provides several estimates of demand for new teachers through 2020. First, concentrate on the solid line, which is our preferred estimate of future demand for new teachers. In this scenario, just under 280,000 teachers are added in the 2009–10 school year, or about 9 percent of the projected 3.2 million teacher work force. Over the coming decade, the total number of new teachers needed to fill growth in demand,

TABLE 2

Impact of age, gender, experience, and tenure on teacher labor market transitions

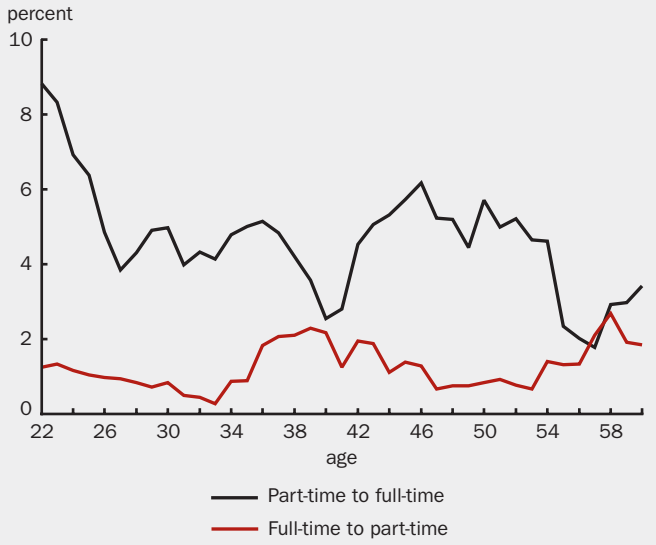
	Coefficient	Standard error		Coefficient	Standard error
Age 22, Male	8.093646	29105.29	Age 22	0.584441	0.000148
Age 23, Male	0.024761	0.000281	Age 23	0.50437	0.00011
Age 24, Male	–0.10479	0.000203	Age 24	0.561063	0.000106
Age 25, Male	–0.15153	0.000187	Age 25	0.34095	0.000103
Age 26, Male	1.350913	0.000296	Age 26	0.133373	0.000095
Age 27, Male	0.206976	0.000176	Age 27	0.11059	9.81E-05
Age 28, Male	0.930092	0.000201	Age 28	–0.19276	8.95E-05
Age 29, Male	0.804145	0.000193	Age 29	–0.10115	8.75E-05
Age 30, Male	0.392089	0.000191	Age 30	–0.02861	8.89E-05
Age 31, Male	0.176934	0.000179	Age 31	0.266742	0.000106
Age 32, Male	0.563326	0.000184	Age 32	–0.10671	0.000104
Age 33, Male	–0.11639	0.000198	Age 33	0.37932	0.000102
Age 34, Male	0.486308	0.00019	Age 34	0.04453	8.92E-05
Age 35, Male	0.060937	0.000193	Age 35	0.220451	0.000109
Age 36, Male	0.456112	0.000205	Age 36	0.318921	0.000109
Age 37, Male	0.591015	0.000249	Age 37	0.394561	0.000106
Age 38, Male	–0.27538	0.000178	Age 38	0.198718	0.000121
Age 39, Male	–0.05095	0.000223	Age 39	0.027583	0.000117
Age 40, Male	1.000113	0.000365	Age 40	0.10183	0.000102
Age 41, Male	-0.64211	0.000175	Age 41	0.614629	0.000113
Age 42, Male	0.492821	0.000233	Age 42	0.279795	0.000106
Age 43, Male	0.462676	0.000204	Age 43	0.161943	9.89E-05
Age 44, Male	0.017997	0.000201	Age 44	0.039813	9.88E-05
Age 45, Male	0.784613	0.000246	Age 45	0.10397	9.84E-05
Age 46, Male	–0.00701	0.000216	Age 46	0.528427	0.000114
Age 47, Male	0.305273	0.000236	Age 47	0.645033	0.000105
Age 48, Male	–0.79063	–0.00018	Age 48	0.37092	0.000106
Age 49, Male	0.209362	0.000194	Age 49	0.390664	0.000109
Age 50, Male	0.480825	0.000239	Age 50	0.257623	0.000102
Age 51, Male	0.014518	0.000198	Age 51	0.247397	9.66E-05
Age 52, Male	0.126609	0.000162	Age 52	0.003844	8.52E-05
Age 53, Male	0.047295	0.000181	Age 53	0.049014	9.13E-05
Age 54, Male	0.361217	0.000156	Age 54	–0.19105	8.79E-05
Age 56, Male	0.007383	0.000149	Age 55	–0.10263	0.000082
Age 57, Male	0.214801	0.000159	Age 57	–0.24693	9.67E-05
Age 58, Male	0.510085	0.000205	Age 58	–0.4417	0.000124
Age 59, Male	0.77383	0.000189	Age 59	–0.58112	9.96E-05
Age 60, Male	–0.23118	0.000199	Age 60	–0.33222	0.000104
Age 61, Male	0.055861	0.000245	Age 61	–0.84614	0.000143
Age 62, Male	0.262981	0.00029	Age 62	–1.05536	0.000138
Age 63, Male	–9.97802	19421.77	Age 63	–0.05081	0.000185
Age 64, Male	–1.72697	0.000889	Age 64	–1.13825	0.000121
Age 65, Male	–1.89667	0.000572	Age 65	0.190768	0.000311
Age 66, Male	–9.83992	54831.4	Age 66	–0.24195	0.000197
Age 67, Male	–1.72607	0.000544	Age 67	–0.83847	0.000181
Male				–0.11158	0.000108
≤5 years of total experience				–0.17221	3.26E-05
≤3 years of current experience				–0.15405	3.08E-05
4–32 years of current experience				0.057591	3.17E-05
≥33 years of current experience				–0.86998	8.49E-05
Full-time in 2003				0.969324	3.59E-05

Notes: There are three types of transitions from year to year: exiting out of the teacher work force; becoming or remaining a part-time teacher; and becoming or remaining a full-time teacher. The model is estimated using an ordered probit with the data sources.

Sources: Authors' calculations based on data from the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003–04 *Schools and Staffing Survey* and 2004–05 *Teacher Follow-up Survey*.

FIGURE 3

Transition rates to full-time and part-time teaching positions, by age



Note: These transitions rates are computed as five-year weighted moving averages.
Sources: Authors' calculations based on data from the U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003–04 *Schools and Staffing Survey* and 2004–05 *Teacher Follow-up Survey*.

as well as replace exiting teachers, grows by just over 2,000 per year, hitting 303,000 by 2020. From 2009 through 2020, roughly 3.5 million net teachers need to be added.

The shaded region provides alternative estimates, with the outer ranges suggesting plausible upper and lower bounds of hiring required when we adjust three key factors: the U.S. Census's assumed fertility rate, the estimated teacher turnover rate, and the estimated student–teacher ratio. The fertility rate is allowed to vary by plus or minus 1 percentage point from our baseline, with this range determined by U.S. Census's high and low population projections.[16] The teacher exit rate is also allowed to vary by plus or minus 1 percentage point from our estimated average 7.8 percent baseline rate.[17] This encompasses several alternative estimates, including the 2004–05 TFS turnover rate that weights full-time and part-time teachers equally (8.4 percent) and turnover rates from the *Current Population Survey*'s 2003–04 outgoing rotation file for full-time teachers (8.4 percent) and full-time college-educated teachers with annual incomes between $10,000 and $150,000 (6.9 percent). Finally, the bounds on the student–teacher ratio are allowed to range between the NCES's high assumption projection and a constant ratio based on values from the 2003–04 SASS. The edges of the shaded region use all three assumptions that result in the highest or lowest projection of the demand for new teachers. Taken together, these adjustments broaden the range of plausible new teacher demand to between 2.3 million and 4.5 million from 2009 through 2020. Approximately 42 percent of this range is due to changes in the assumed birth rate, 33 percent to changes in the assumed turnover rate, and 25 percent to changes in the assumed student–teacher ratio.

The dashed line shows the number of new teachers arising from retirements. We find that roughly 30 percent to 35 percent of demand for new teachers between 2009 and 2020 is due to openings created by retirements. Retirements rise from about 82,000 in 2003–04 to just under 96,000 in 2009–10 and average around 96,000 per year over the next decade.

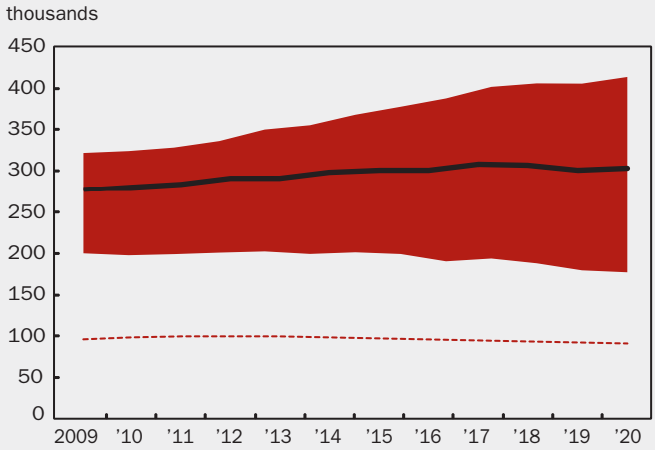
Including private schools

Thus far, we have only included public school teachers. We can compute simple projections for private school new teachers by applying the overall turnover rate of 10.7 percent among private school teachers in the SASS to current staffing levels and NCES projections of the demand for private school classrooms through 2015.[18] In our baseline scenario, private school demand for new teachers rises from roughly 55,000 in 2009 to almost 62,000 in 2015. Projecting this trend forward to 2020 would imply about 725,000 new private school teachers between 2009 and 2020—about a fifth of the public school net demand for new teachers over the same time period.

The ratio of private school students to public school students is about 13 percent, significantly less than the ratio of projected private school to public school new teacher demand. That is mostly explained by a higher overall teacher turnover rate in the private sector (roughly 3 percentage points higher). One consequence of these sector-specific dynamics is that under 10 percent of net private school hiring through 2020 is driven by retirements, suggesting that the retirements of baby boomers will have significantly less impact in private schools over this period. If we aggregate the public school and private school sectors, 29 percent of net teacher hiring is due to retirements (in the SASS)—which is less than the 32 percent of net teacher hiring due to retirements among public schools alone.

FIGURE 4

Projected demand for new public school teachers, 2009–20



Notes: Demand for new teachers was estimated for 2004–08 (not shown), since actual hiring data for those years are not available, and then carried through 2020. The solid line is our preferred forecast. The shaded region encompasses the plausible range of estimates. The dashed line shows openings created by retirements. See the text for further details.

Sources: Authors' calculations based on data from U.S. Census Bureau, population estimates and projections; U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003–04 *Schools and Staffing Survey*, 2004–05 *Teacher Follow-up Survey*, and compilation of yearly national student counts by grade and type of school, 1999–2003; and Hussar and Bailey (2007), table 33.

Are these projections historically high?

Of course, there are always retirements. The key question is how unusual hiring might be given the baby boomer retirements. We provide some historical context by comparing U.S. Census-based estimates of future changes in new full-time public school teacher demand with past changes.[19]

Because of data limitations, we provide very rough approximations of changes in demand for new full-time public school teachers during a decade by adding growth in the full-time teacher labor force to the number of teachers who are of retirement age. The idea behind this calculation, which clearly understates year-to-year hiring, is that it consistently measures all well-observed new full-time public school teachers that 1) fill newly created positions and 2) replace retirees. The number of retirees is conservatively estimated as those who are at least age 55 at the beginning of the decade (and thus retire by age 65). The demand for new full-time public school teachers is plotted in figure 5. We make comparable projections for 2010 and 2020, which vary from our more detailed projections reported previously but are consistent with the historical data.[20]

The red line again shows the rise in new full-time public school teachers needed in the coming decade. But it also shows that the 1970s was a time when hiring was brisk. The reasons, of course, differ. In the 1970s, 72 percent of our new teacher demand measure was necessitated by growing populations of school-age children. By contrast, between 2010 and 2020, we expect that only around 31 percent of this measure of the demand for new teachers will be due to student population growth. The remainder will be due to teacher retirements.

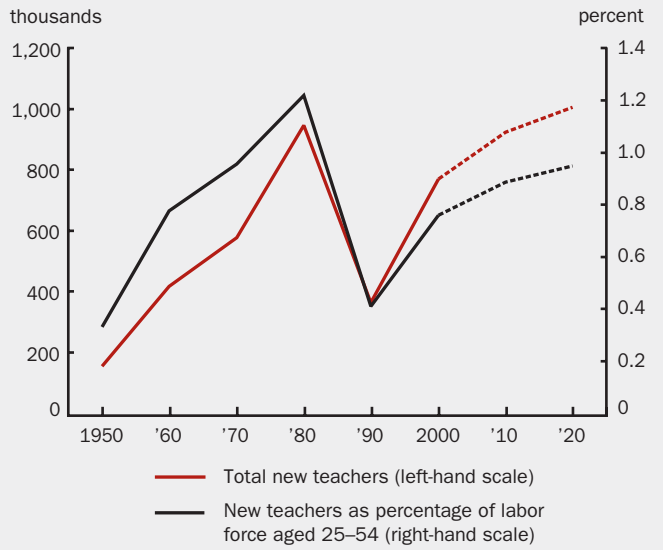
We recognize that comparing absolute numbers is misleading because the size of the aggregate population, and consequently the potential and actual teacher work pool, has grown over time. Therefore, the black line normalizes our new teacher numbers by the population aged 25–54. Here, we find that this ratio is not unusually high right now, nor do we expect it to become unusually high in the near term. Demand for new teachers as a percent of the labor force aged 25–54 is expected to average 0.91 percent between 2010 and 2020—just above the 0.83 percent average between 1960 and 2000 (and below the 0.96 and 1.20 percent levels reached in 1970 and 1980). This suggests modest concerns about filling teacher vacancies in the aggregate.

Demand for new teachers by school demographics

Obviously, not all schools face the same future hiring requirements; the effect of the baby boomer retirements could put particular strain on some more than others. We explore this issue by looking at the key parameters in our forecasts when schools are stratified by region,[21] urban or rural status, share of students receiving free or reduced price lunch, and share of students who are minorities. For each of these categories, table 3 reports the share of teachers over age 50 and 55 (first and second columns of data), the hours turnover rate for new and experienced teachers (third, fourth, and fifth columns), the student–teacher ratio (sixth column), and the growth rate of the student population (seventh column).[22] The eighth column provides results from simulations of new teacher demand, using the same methodology as in figure 4, but assuming that the entire teacher labor market takes on parameters of a subpopulation (as described in the leftmost column). Those numbers are reported relative to the baseline forecasts of the nationally representative population.

FIGURE 5

Demand for new full-time public school teachers



Notes: All part-time teachers are dropped from our calculations. Dashed lines indicate forecasts.
Source: Authors' calculations based on data from U.S. Census Bureau, population estimates and projections.

On average, schools that should expect to see unusually high demand for new teachers are in the West and South; they are located in large cities and small towns; and they educate high shares of minority and low-income students. The particular explanations vary somewhat by school characteristic. However, retirements do not seem to be driving any of the results in an economically significant way. For example, we stratified schools into quartiles based on the fraction of minority students (the bottom two quartiles are aggregated for simplicity).[23] While the top quartile has a higher fraction of teachers aged over 55, there is no statistical difference in the share of teachers aged over 50 across the racial minority representation quartiles. If we leave all parameters at the top quartile's level but switch the age distribution of the teachers so that it matches the schools at the bottom half of the minority representation distribution, overall new teacher demand increases by only 4 percent. Consequently, there is little evidence that baby boomer retirements will affect schools with a high proportion of minority students any *more* than other schools.

Additional hiring demands in schools that have student populations with high minority representation or those with many low-income members (who receive free or reduced price lunches) are driven almost entirely by higher turnover propensity and expected student population growth. Putting all these pieces together, we would predict that if all schools had the characteristics of schools with a high proportion of minority students, the demand for new teachers would be 65 percent higher than the baseline forecasts over the forecast horizon. Over 60 percent of this gap is explained by differences in turnover rates across the age/experience distribution, and just under half by differences in expected student population growth rates. Similar issues arise for schools with high fractions of free or reduced price lunch program participants or for those in urban areas, many of which are also schools with a high fraction of minority students.[24]

What can policy do? The case of teacher compensation

Finally, we ask how policy can respond if community demand for new teachers increases beyond historical norms. Obviously, there are many factors that affect teacher labor supply—a short list of which would include salaries, pension systems, classroom and school conditions, and certification requirements and other barriers to entry. We concentrate on teacher financial compensation because of its relevance to policy discussions and because of the attention that has been paid to its estimation in the literature.

That attention in the literature certainly does not imply a consensus. A number of recent papers have established a link between teacher salary, outside work alternatives, and turnover (for example, Dolton and van der Klaauw 1995, 1999; Murnane and Olsen 1989, 1990; Stinebrickner, 1998; and Harris and Adams, 2007). But others (for example, Scafidi, Sjoquist, and Stinebrickner, 2006; Hanushek, Kain, and Rivkin, 2004; Clotfelter et al., 2008; and Ondrich, Pas, and Yinger, 2008) cast doubt on these findings. We concentrate on the larger estimates of the impact of salary on turnover in the literature and therefore consider our results to be a lower bound estimate of the effect of raising teacher salaries on future demand for new teachers.

We mechanically introduce the impact of an across-the-board salary adjustment to our transition probabilities by adjusting potential exit rates using salary–turnover elasticities from various studies.[25] For our original cohort of 2003 public school teachers, we use the "overall" (that is, representative of the entire public school teacher labor force) elasticity estimate from Harris and Adams (2007). For the

TABLE 3

Key parameters and projected demand for new teachers, by school characteristics

	Age distribution of teachers, 2003–04		Teacher hours turnover rate, 2003–04 to 2004–05			Student–teacher ratio, 2003–04	Percent change of student population growth rate, 2008–20	Percent change in new teachers relative to baseline
	Age >50	Age >55	New	Age 25 to 35	Age >50			
Northeast	0.317***	0.135***	0.063	0.073	0.129	12.8***	–1.9	4.4
Midwest	0.313***	0.121*	0.000*	0.071	0.108	14.2***	0.6	–10.3
South	0.273***	0.118***	0.093	0.055	0.104	14.2***	25.4	27.4
West	0.304	0.140***	0.054	0.107*	0.102	17.9***	24.8	6.2
Percentile of free/reduced price lunch students								
>75 percentile	0.279***	0.120**	0.136**	0.124	0.123	14.4***	—	53.7
50–75 percentile	0.297	0.124	0.029	0.062	0.125	14.3***	—	13.8
<50 percentile	0.305***	0.130**	0.018	0.045	0.098	15.2***	—	–20.9
Large or mid-sized central city	0.301	0.131**	0.137**	0.103*	0.130*	15.4***	—	23.7
Urban fringe	0.296	0.128	0.000**	0.058*	0.096	15.3***	—	–10.4
Small town/rural	0.293	0.114***	0.104	0.063	0.124**	13.3***	—	26.5
Percentile of minority students								
>75 percentile	0.296	0.141**	0.203***	0.114*	0.122	15.5***	21.6	65.4
50–75 percentile	0.291	0.118***	0.034	0.069	0.106	15.1***	10.0	23.0
<50 percentile	0.300	0.122***	0.000**	0.045*	0.106	14.3***	–0.8	–26.2
Observations	42,310		675	1,629	1,673			

*Statistically significantly different from the remaining population at the 10 percent level.
**Statistically significantly different from the remaining population at the 5 percent level.
***Statistically significantly different from the remaining population at the 1 percent level.

Notes: Student growth rates are from U.S. Census Bureau's population projections. All other parameters are computed from the 2003–04 *Schools and Staffing Survey* and 2004–05 *Teacher Follow-up Survey*. Hours turnover accounts for changes between part-time status and full-time status. If switches from part-time to full-time more than offset lost hours through exits and switches from full-time to part-time, we report the hours turnover rate as 0. The final column reports the percent change in net demand for new teachers relative to the baseline if the full population had the subpopulation characteristics.

Sources: Authors' calculations based on data from U.S. Census Bureau, population estimates and projections; U.S. Department of Education, Institute of Education Sciences, National Center for Education Statistics, 2003–04 *Schools and Staffing Survey*, 2004–05 *Teacher Follow-up Survey*, and compilation of yearly national student counts by grade and type of school, 1999–2003; and Hussar and Bailey (2007), table 33.

cohorts of new teachers introduced into our model, we use the "new teacher" salary–turnover elasticities (calculated for teachers during their first five years of teaching) reported in Dolton and van der Klaauw (1995), Stinebrickner (1998), and Harris and Adams (2007).[26] For those new teachers that survive past their fifth year, we switch them to the "overall" exit elasticity once they complete that fifth year. We continue to assume that the fraction transitioning to part-time or full-time teaching positions remains the same; that is, these transitions are unaffected by new salary levels. We also assume that these salary effects do not differ across school types, as described in Hanushek, Kain, and Rivkin (2004).

In the aggregate, we calculate that annual wage growth about 0.8 percentage points beyond average pay growth would offset much of the additional net new demand for teachers over the coming decade, relative to the early 1990s. Specifically, the ratio of teacher hiring to the size of the general labor force between 1988 and 1995 was about 0.00144. We project that this ratio will fluctuate between 0.00178 and 0.00184 during the 2010s. To get the ratio back to 0.00144 by 2020 would require roughly an additional cumulative wage growth of 10 percent between 2009 and 2020. By comparison, cumulative real weekly wage growth of teachers in the *Current Population Survey* was 9 percent between 1989 and 2004, suggesting that the pay hike needed to reach this fairly ambitious target is relatively large.

Teacher pay would have to be especially bolstered in schools with high proportions of poor and minority students in order to offset their expected teaching needs over the coming decade. For example, if a goal was to reduce the demand for new teachers in schools with a high fraction of minority students from 65 percent to 30 percent above baseline national needs by 2020 (thereby offsetting the turnover and retirement rate differences in these schools), average real pay for teachers would have to rise by well over 25 percent.

How does the recent recession impact our estimates?

The data underlying our projections are not available for the current downturn; this is unfortunate, since our predictions could be affected by a significant decline in economic activity. Economic theory predicts at least three ways in which demand for new teachers might be altered by a recession: through changes to the fertility rate, immigration, and teacher attrition (including retirements).[27]

Both fertility rates and net migration flows are commonly observed to fall during recessions, and early indications are that both measures have fallen during the current downturn.[28] Lower migration will reduce demand for teachers now, and lower fertility will reduce demand five years hence. Moreover, children of immigrant parents tend to be disproportionately from low-income families and clustered in a few large urban areas.[29] Therefore, it is possible that lower net migration will help to relieve some constraints in schools where the demand for new teachers is projected to be relatively high.

Lower teacher attrition, and consequently lower replacement hiring, is also possible as household wealth declines and alternative labor market opportunities evaporate. Because of these factors, we would speculate that some additional weight should be placed on our lower bound projections in figure 4 (p. 9) for the next couple of years. Beyond that, we think that consensus economic forecasts[30] imply that these cyclical effects will fade away.

Conclusion

In this article, we provide a simple model of teacher demand and supply in order to gauge the implications of baby boomer retirements on demand for new teachers over the coming decade. We find that the demand for new teachers will rise over the coming decade—and a good portion of this will be due to retirements. That said, we do not expect that this increase in teacher demand will be significantly different from that of past decades, especially relative to the size of the aggregate labor force. However, the added hiring requirements are likely to play out longer than they have in the past, and they will not be equally dispersed across the nation. Moreover, simply raising pay, unless substantially unanchored from past trends, is unlikely to keep teacher quality constant, especially at schools that have traditionally had the most difficulty recruiting and retaining teachers.

NOTES

[1]See, for example, Murnane (1975); Rockoff (2004); Rivkin, Hanushek, and Kain (2005); and Aaronson, Barrow, and Sander (2007). Unsurprisingly, experience is correlated with productivity across a variety of professions. Recent estimates (for example, Aaronson and Sullivan, 2001) suggest that the loss of human capital from the baby boom generation, primarily through lost experience, will be enough to lower the potential rate that the economy can grow during the 2000s by one-tenth to two-tenths of a percentage point per year from its 1990s levels.

[2]Over the past two decades, the share of teachers that have left the profession has been increasing, from roughly 5 percent of teachers in the early 1990s to over 8 percent a decade later. For an example of popular press concern about teacher turnover, see Dillon (2007). See Gordon, Kane, and Staiger (2006) for a discussion of the impact of baby boomer retirements on the teaching profession.

[3]Hanushek, Kain, and Rivkin (2004); and Jacob (2007).

[4]We define a full-time public school teacher as one who works 35 hours per week. Teachers who work fewer hours are counted as fractions of full-time teachers. Unless otherwise indicated, this is how we count teacher demand and supply in our calculations.

[5]Our model also assumes that variability in the business cycle looks similar to that of the past. Given the current deep recession, there may be some concern that this assumption is inaccurate. Unfortunately, key data from recent years are unavailable. Later in the article, we briefly discuss how our estimates might change as a result of the current recession.

[6]Detailed calculations and data are available from the authors upon request.

[7]We thank William Hussar at the NCES for providing us with student counts, by type of school and grade, for the years 1970–2003. We used these data to calculate the progression rates. A number above 1 implies a net influx of students coming into public schools in that particular grade either from private schools or schools without grade levels or home schooling; or it implies an influx of children entering the U.S. school system for the first time (recent immigrants). This is particularly notice able in the transition between eighth and ninth grades and kindergarten and first grade. In order to put heavy weight on more recent history, we used the average from 1999–2003 only. Our results do not change appreciably if we take into account the longer time series.

[8]These are available at www.census.gov/ipc/www/usinterimproj/. These projections are an interim revision of more detailed forecasts released in 2000; the forecasts have been updated to take into account the 2000 U.S. Census. In the sensitivity analysis to follow, we use the high and low series from the original projections released in 2000. We have also tried using the five- and six-year-old population, but this resulted in kindergarten projections that were less accurate when compared with similar NCES student projections.

[9]We calculate the share of five year olds attending public school over time, using population estimates by age from the U.S. Census and the student counts by grade from the NCES. Some of the changes in the share of five year olds attending public school may line up with the business cycle. We found some very mild, but not particularly robust, evidence of procyclicality. But that appears to be driven primarily by a correlated drop in both gross domestic product (GDP) growth and public school attendance of five year olds in the early 1990s.

[10]The average annual drop in the public school student–teacher ratio for the school years 1991–92 through 1998–99 was –0.15, according to Hussar and Bailey (2007), whereas the average annual drop for the school years 1999–2000 through 2003–04 was –0.06. The average decline predicted by the NCES's high assumption for the school years 2004–05 through 2015–16 is –0.10. Mechanically, we compute the student–teacher ratio in our SASS data for 2003 and then apply the year-to-year differences in the average of the NCES's high assumption and a flat student–teacher ratio. Because the NCES ratio is projected out to 2016, we use the rate of growth since 2004 to project ratios further into the future.

[11]This count excludes pre-kindergarten teachers and short-term substitutes. We find that the count of full-time and part-time teachers in the 2003–04 SASS is consistent with similar counts in the U.S. Census Bureau's 2004 *American Community Survey* (ACS) and NCES *Common Core of Data* (CCD). To make the ACS sample comparable, it is necessary to exclude teachers categorized as "other," which includes short-term substitutes and instructors working outside of public elementary and secondary education, and to restrict the sample based on education and salary. Doing so provides a sample that is similar not only in count to the SASS but also in the distribution of education, age, and earnings.

[12]Obviously, there are other teacher characteristics that can affect turnover. To take one important example, Podgursky, Monroe, and Watson (2004) and Corcoran, Evans, and Schwab (2004) estimate the impact of teacher ability on teacher retention. Later, we discuss how the fraction of low-income students, racial composition, urban or rural status, and geographical location of a school affect teacher turnover propensities.

[13]In order to count the number of teacher hours lost in this transition, it is necessary to quantify the "amount of teacher" added or subtracted when a teacher switches from part-time to full-time status or vice versa. The average part-time teacher in the sample works roughly 60 percent of a full-time teacher's hours (which again is defined as 35 hours per week). Therefore, a teacher who switches from full-time to part-time status is counted as 0.6 of her original weight, and a teacher who switches from part-time to full-time status is counted as 1.67, or 1/0.6, of her original weight.

[14]In particular, we use the demographic distribution of teachers who were not teaching in public schools in the prior year. On average, these teachers are eight years younger (and eight years less experienced) than returning public school teachers. Gender composition is nearly identical between the two groups of teachers.

[15]Since the labor force—both teacher and overall labor force—has been growing older, this could reflect the distribution of new teachers as well. In order to examine how demographic change affects our forecasts, we used U.S. Census population projections by age and gender to project the age and gender distribution of new teachers from 2004 through 2020. We found that adjusting our estimates to take into account an increasing fraction of older teacher hires does not make a large difference in our projections. The baseline of new teachers increases by just under 2 percent and retirements increase by 4 percent by school year 2020–21.

[16]The U.S. Census does not report revised interim high and low projections. Instead, we applied the growth rates of the high and low projections from the detailed U.S. Census projections released in 2000 to recalibrate new high and low projections that are in line with the revised middle forecast (see note 8 for further details).

[17]A component of this assumption is the age of retirement over time. We currently assume that the age of retirement stays constant at the 2003–04 level. The median age of teacher retirements in the 2003–04 outgoing rotation files from the *Current Population Survey* is 60.0, quite close to the average median age of 60.3 between 1994 and 2005. We see little evidence of a trend in this series. However, if the retirement age declined by one year during the period 2004–20, this would be equivalent to an increase of

0.6 percentage points in the exit rate over this time period; this implies a 2.2 percent change in net new teachers between 2009 and 2020 if we assume uniform year-to-year increases in the exit rate.

[18]By using the NCES projections, we explicitly accept NCES's assumption that factors influencing private school and public school enrollments, such as transfers to and from private and public schools, migration, dropouts, deaths, and grade promotion will display future patterns consistent with past patterns. The NCES uses past grade progression rates to project enrollment.

[19]For these calculations, we restrict the U.S. Census sample to full-time teachers only. The U.S. *Decennial Censuses* include short-term substitutes and other instructors who do not teach in public schools. Moreover, education requirements and salary ranges change over time. Therefore, it is not clear how to restrict the historical Census samples to make them comparable to SASS counts.

[20]More specifically, these forecasts are computed by applying age-specific teacher retention rates using the U.S. Census Bureau's *American Community Survey* from 2001 through 2006 and the student–teacher ratios and U.S. Census projections of the school-age population as discussed previously. As with calculations using U.S. Census data for new teacher demand in previous decades, estimates for new teacher demand from 2000 through 2010 and from 2010 through 2020 are computed by adding the number of teachers over 65 to the growth in the demand for full-time public school teachers.

[21]Unfortunately, sample sizes preclude reliable results at smaller levels of geography.

[22]We take the student growth rate from U.S. Census population projections, which do not report results by urban or rural status or by free or reduced price student lunch status. Consequently, the rural versus urban status and lunch status simulations assume average student growth over the entire population for all school types. This mechanically mutes the comparison with minority or regional subpopulations. Note also that the hours turnover rate accounts for changes in part-time and full-time status, as well as exits. Because the transition from part-time to full-time is relatively common (see figure 3, p. 8), especially for new teachers, that transition can more than offset hours lost from exit and from full-time to part-time switches. In such cases, we report the hours turnover rate as 0.

[23]For racial composition, the top quartile comprises schools with at least 75 percent minority representation. The second quartile comprises schools with 29 percent to 75 percent minority representation. For free/reduced price school lunch composition, the top quartile comprises schools with at least 61 percent free or reduced price lunch students, and the second quartile comprises schools with 37 percent to 61 percent free or reduced price lunch students.

[24]Another example where inner-city schools might be disadvantaged is described in Boyd et al. (2005). That paper shows that teachers often work in areas near where they grew up. This can make it more difficult to hire teachers for districts with alumni who do not go into the teaching profession.

[25]Of course, an across-the-board salary increase affects the transition decisions of both high- and low-quality teachers. As much as it creates an incentive for the low-quality teachers to stay longer, it may not necessarily improve overall teacher productivity.

[26]It is important to note that in our model, some teachers may be returning to teaching after a break. In the literature, the elasticities tend to be computed for the first five years of teaching experience.

[27]Another channel is larger class sizes. However, we find little evidence of countercyclical movements in class size during the previous two business cycles. That said, pressures on state and local governments have been notably more severe during this recession.

[28]Analysis using the March *Current Population Survey* shows that the number of recent immigrants in 2008 (that is, foreign-born residents who moved to the United States last year) was down 7 percent from 2007 and 30 percent from 2006. The Centers for Disease Control and Prevention's National Center for Health Statistics reports a decline of 0.5 percentage points in fertility rates during early 2008 relative to the previous few years.

[29]Roughly one-fifth of school-age children are from immigrant families, up from 6 percent in 1970, and these children are concentrated in states with the largest urban school districts, for example, California, New York, Texas, Florida, Illinois, and New Jersey (Capps et al., 2005).

[30]See, for example, the Federal Reserve Bank of Philadelphia's *Survey of Professional Forecasters*, available at www.phil.frb.org/research-and-data/real-time-center/survey-of-professional-forecasters/.

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