Returns To Seniority Among Public School Teachers

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ABSTRACT

Returns to seniority account for a substantial share of public K-12 expenditures. Over the first ten to 15 years of a career, public school teachers enjoy average wage growth at least equivalent to that of other white-collar workers. Explanations for this structure in terms of human capital or costly monitoring lack theoretical and empirical support. A steeper wage-tenure profile reduces turnover, but it is doubtful that the costs of turnover are high enough to make this an optimal use of school resources. We conclude that the structure of teacher pay in public education is more consistent with rent-seeking than efficient contracting.

I. Introduction

The relationship between seniority and compensation has been a focus of much theoretical and applied research in labor economics. Some researchers have taken the stylized fact of the upward-sloping seniority-earnings profile as a given and attempted to provide theoretical explanations for the phenomenon (Oi 1962; Lazear 1979). Others have attempted to estimate returns to seniority within a larger literature that investigates establishment differentials in worker pay (Abowd, Kramarz, and Margolis 1999; Bronars and Famulari 1997; Troske 1999).

The compensation system for public school teachers is an unusual case in which the return to seniority can be observed directly. The pay of public school teachers is determined by salary schedules as a function of years of service (rows) and education credentials (columns). The return to seniority thus takes the form of moving down the rows with years of service and moving across the columns as a teacher accumu-

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lates graduate education credits. Over time, upward shifts in the schedule also affect cumulative within-job wage growth. In private firms with positive seniority-wage profiles, these returns are often the result of promotions up job ladders in an internal labor market. This is not the case in public schools, where seniority-based pay increases are essentially automatic.

A significant portion of public school budgets is spent rewarding teacher seniority. Using data from the 1993–94 Schools and Staffing Survey, we arrive at a rough estimate of total spending on teacher seniority of $24.4 billion, 17 percent of public K-12 expenditures on instruction in that year. This figure would increase by five billion if it included payments for earning a master's degree. Moreover, our estimate is conservative in that it does not include increases in fringe benefits such as pensions that are functionally related to salary.

It is not obvious that this money is well spent. Teaching is an aging profession, many of whose members are due to retire within the next decade. While several measures may be required to recruit adequate numbers of capable new teachers, higher salaries are apt to be part of the policy mix. To the extent the extra money is spent rewarding seniority rather than raising entry-level salaries, we can expect less impact on the number and quality of new recruits. Whether this is a wise policy or a misallocation of funds therefore depends on the underlying justification for current wage-tenure profiles.

We begin this study by reviewing compensation policies in public schools. We then compare teacher salaries to other workers. For those teachers who have not yet reached the top of their district schedule, we find that public schools spend about the same percentage of the wage rewarding seniority as do other employers. Next we consider whether the same theoretical justifications for an upward-sloping wage-tenure profile hold in education as elsewhere in the economy. Our negative finding on this point leads us to consider the influence of teacher organizations on compensation policy though collective bargaining and political activity. This evidence suggests that rent-seeking has an important effect on the structure of teacher compensation.

II. Returns to Seniority Among Public School Teachers

The empirical literature on wage-tenure profiles has focused on distinguishing returns to tenure from returns to experience.[1] This distinction will not concern us here, as our subject is the within-job wage growth, or how much public

1. Prominent examples are Altonji and Shakotko (1987); Abraham and Farber (1987); and Topel (1991). The distinction between returns to tenure and returns to experience is much less important in public education. Statistical analysis of salary data from the 1993–94 SASS shows that while public school teachers, on average, receive less than full credit for prior experience, the difference is very small. Each year of full-time public school experience increases the log of salary by 0.027. Every year of service outside the district in which the teacher is currently employed reduces this by 0.003. Thus, on average teachers lose credit for one year in nine when they change districts. Because the analysis was based on teachers with no more than twelve years' experience, there should be little downward bias in these figures due to ceiling effects among teachers who have attained the maximum salary on their district schedule.

schools are paying for teacher experience. Throughout this paper, when we speak of returns to tenure or returns to seniority, it should be understood that we refer to the return to tenure and experience combined.

At a point in time, the return to seniority for teachers is established by the annual step increments in a district's salary schedule. A teacher's position on the schedule is determined both by the number of years of service within the district as well as credit for prior teaching experience elsewhere. Characterizing these returns is complicated by wide variation in the number of steps. In some urban school systems, teachers reach the top of the salary schedule in as few as seven years. By contrast, schedules in some Southern districts contain 30 or more steps. Any effort to describe returns to tenure must take into account both how rapidly salary grows over time as well as the number of years in which teachers receive step increments.

Returns to tenure are not exhausted by annual step increments. Many districts confer additional raises on senior teachers in the form of longevity pay, awarded when they pass certain milestones of service (for example, 20 years, 25 years, 30 years). Typically, longevity bonuses are received every year until the teacher's years of service reach the point at which the next longevity increment is triggered.

No representative national sample exists with data on salary schedule steps and levels of pay. The best available source of information is a survey of districts in the 200 largest cities conducted annually between 1986–87 and 1997–98 by the Department of Defense (DOD) and published on the internet by the American Federation of Teachers (AFT 1999). Although no claim is made that this sample is nationally representative, size alone makes it worthy of study. In 1991, 502,000 teachers were employed in these districts, 21 percent of the nation's K-12 public school instructors.

The DOD survey asked districts for the starting pay of teachers holding a Bachelor of Arts degree (BA), the salary the teacher would earn on the top step on the schedule, and the number of steps to the top. The same three questions were asked about teachers with a master's degree (MA). We interpolated the intervening steps on the schedule by assuming equiproportionate increments.[2] We then calculated how much more districts paid teachers with ten years experience than teachers with none. Results for the 1993–94 school year are displayed in Table 1. Three measures of the return to tenure were computed, depending on a teacher's level of education. As shown in Row 1, an instructor with ten years seniority and a BA earns on average 32 percent more than a beginning teacher with the same level of education. (This is the unweighed average across districts. Results when districts are weighted by the number of teachers, also displayed in Table 1, are similar.) If both teachers have a master's degree, the mean difference is 36.5 percent. Finally, a teacher with ten years

2. We tested this assumption using actual (self-reported) salary data from the 1993–94 Schools and Staffing Survey for teachers in the DOD districts. The log of the interpolated value was subtracted from the log of actual pay and the difference regressed on a fourth-degree polynomial in experience to examine departures from equiproportionality. The model was fit separately for teachers whose highest degree was a BA ($N = 2{,}418$) and an MA ($N = 1{,}401$), respectively. Only teachers whose full-time experience was less than the number of steps on the schedule were retained in the estimation sample. Results strongly confirmed the equiproportionality hypothesis. Although the coefficients on experience and its higher-order terms were all statistically significant, neither equation explained more than 3 percent of the variance in the dependent variable. A plot of predicted salary values on a logarithmic scale was virtually linear.

Table 1
Salary Growth for Beginning Teachers, DOD Large Cities Data, 1993–94

		Unweighted		Weighted by Number of Teachers	
	N	Mean	Standard Deviation	Mean	Standard Deviation
1 Cumulative salary growth, starting & ending with BA, %	195	31.8	14.5	33.1	13.9
2 Cumulative salary growth, starting & ending with MA, %	188	36.5	14.6	34.7	13.2
3 Cumulative salary growth, starting with BA & ending with MA, %	187	48.2	17.7	46.3	16.3
4 Correlation between (1) and starting pay for teachers with BA	195	0.20**	—	0.29**	—
5 Correlation between (2) and starting pay for teachers with MA	188	0.30**	—	0.37**	—

**Significant at 1 percent.
Source of Data: Department of Defense large cities teacher salary survey.

of experience and an MA earns 48 percent more on average than a new teacher with a bachelor's degree.

Although this last calculation appears to confound returns to tenure with returns to education, the evidence that holding an advanced degree improves teaching performance is decidedly mixed, with almost as many studies showing a negative relationship as a positive one and many failing to meet conventional levels of statistical significance (Hanushek 1986). Courses leading to an MA are conveniently offered in summer months and frequently involve minimal amounts of work. Although there are some master's programs of high quality, salaries do not reflect such qualitative distinctions. Unless a teacher chooses a more demanding program, the additional compensation paid teachers with a master's degree is effectively a return for putting in one's time.

Indeed, teaching is unique among professions in that professional degrees are typically earned several years after the onset of one's professional work life. Although most teachers are hired with bachelor's degrees, the majority eventually earn an MA in education. Fourteen states require that teachers earn an MA or a minimum number

of graduate credit hours as a condition for recertification or permanent certification (National Association of State Directors of Teacher Education and Certification 1998). Thus, even if one takes the view that obtaining an MA raises teacher productivity, this situation is closely analogous to on-going training and job-related education provided workers in other occupations. Insofar as the impact of these investments on earnings is measured as a return to seniority/experience, it seems appropriate to treat teachers in the same way.

Table 1 also shows that there is considerable variation in returns to seniority. In a district one standard deviation above the mean, a tenth-year teacher with a bachelor's degree earns 46 percent more than her counterpart who is just starting out. Finally, there is a significant, positive correlation between the ten-year return to tenure and the level of starting pay. Districts that pay higher starting salaries also tend to grant larger step increases. Thus it does not appear that districts typically choose (as one might think) between a strategy of low starting pay with large raises and an alternative in which initial pay is high but increments thereafter are smaller.

III. Returns to Seniority in White-Collar Occupations

To put the data for teachers in context, it would be useful to compare teacher salary schedules with returns to tenure in other occupations. Such comparisons are not easy to obtain. The most prominent studies of the returns to experience and tenure have typically relied on longitudinal data on individual histories in the labor force (for example, Altonji and Shakotko 1987; Topel 1991. Both use the Panel Study of Income Dynamics). Because individuals move among employers, the return to experience estimated from such data need not reflect the value placed by any one establishment on experience. This is particularly apt to affect estimated returns to experience at the beginning of a work life, as new workers transition among entry-level positions, exploring career options. The increase in income that occurs with better matches shows up as a return to experience even when prior work history has little or no influence on the salary offered in the second entry-level job. Indeed, this is precisely the case in public education, where it is rare for new teachers to receive salary credit for previous employment unless directly related to teaching.[3]

For full comparability with public education, we require establishment-level data indicating how much more senior employees are paid within the establishment. According to Bronars and Famulari (1997), there are few studies of employer wage differentials using United States data. Groshen's (1991) analysis of data from the Bureau of Labor Statistics' (BLS) Industry Wage Survey found that the standard deviation of employer wage differentials, conditioning on sex and occupation, was 14 percent of the average wage. Troske (1999) also found significant pay differentials among manufacturing firms using matched data from the Census of Population and the Census of Manufacturers, but neither these data nor the Industry Wage Survey reported tenure on the job or wage growth over time.

3. Estimates using the 1993-94 Schools and Staffing Survey show that for each year of previous work experience, beginning teachers receive an average of $33 over the salary specified in the district schedule. This amount, while statistically significant, is obviously trivial.

More comprehensive data were available to Bronars and Famulari (1997) in a 1989–90 supplement to the BLS White Collar Pay (WCP) Survey. Matched records were provided on 1681 workers in 241 establishments. Starting pay was reported retrospectively for 46 percent of these employees, permitting an investigation of inter-establishment differentials in current pay, starting pay, and the returns to seniority. To control for changes in the wage level over time, salaries were deflated by average hourly earnings of U.S. workers. The resulting estimates therefore approximate the point-in-time returns to seniority that can be read directly off teacher salary schedules.

The returns estimated by Bronars and Famulari vary with worker education and initial experience. The closest comparison group to teachers consists of employees with four years experience when they started the job and 16 years of education.[4] Male white-collar workers in this category experienced cumulative real wage growth of 42 to 51 percent over their first ten years on the job, depending on model specification.[5] The standard deviation of the firm-specific return to tenure was 0.022. Workers at firms where this return was one standard deviation above the mean thus experienced additional wage growth of 25 percentage points over ten years of service. Controlling for two-digit SIC explained 32 percent of the variance in the return to tenure.

Finally, the correlation between returns to tenure and starting wage differentials was −.30, strongly significant. Unlike public school districts, businesses do appear to choose between a policy combining high starting pay with low returns to tenure and an alternative combining lower initial salaries with more rapid growth.

Compared to the information contained in a teacher salary schedule, Bronars and Famulari's estimates provide only a rough idea of the return to seniority. As a measure of the value of seniority at a point-in-time, salary schedules are clearly superior to estimates based on the difference between current pay and starting pay many years apart. Deflating by the national average wage will not put these two numbers on a same "point-in-time" basis if the growth of starting wages at the firm has not moved in lockstep with the average wage in the economy. This seems particularly likely for a sample of white-collar workers, given the well-documented rise in earnings of the college-educated relative to the rest of the workforce. Thus, even after the adjustment for national average wage growth, starting pay and current pay will remain too far apart, yielding an overestimate of the return to seniority at the point in time when the survey was conducted.

One must also regard the standard deviation of within-job wage growth with suspicion. These estimates were obtained using a sample of 736 workers from 130 establishments. This is an average of five employees per establishment. In most cases the

4. According to the 1993–94 Schools and Staffing Survey, the average age at which public school teachers took their first teaching job was 26.

5. These figures are not the numbers reported in Bronars and Famulari's text or their Table 9, as the latter do not properly convert coefficients in a log-linear wage model to percentage changes. The growth rates we have provided are obtained from the full set of coefficients reported in Appendix Tables B and D, converted from logs to levels by the transformation $w = \exp(Xb)$. (The principal difference between the two models is the inclusion of interactions between establishment fixed effects and tenure in the latter.) As returns to seniority among female workers are very sensitive to model specification, we report only the estimates for men.

number will have been smaller. (The distribution is surely right-skewed, so that the median will be less than five. Firms were included in the estimation sample with as few as two workers.) A large component of the establishment-level estimate of the return to seniority will therefore be idiosyncratic error among the employees who happened to have been sampled. This makes the estimate of the establishment-level return to seniority substantially noisier than it is in reality.

We conclude that both the mean and the standard deviation of Bronars and Famulari's estimates suffer from an upward bias. It is instructive to consider, then, how returns to seniority for teachers would change if they were estimated using the same methodology. We have therefore calculated the salary growth a beginning teacher would have enjoyed in each district in the DOD sample over the 11 years those data were collected, from 1986–87 to 1997–98. (A small number of districts that were not surveyed in both years as well as those with missing values had to be dropped from the estimation sample.) Among the remainder, we treat the 1997–98 salary for a teacher with 11 years' seniority as analogous to "current pay" in the WCP survey, and the 1986–87 salary on the first step of the schedule as analogous to the WCP "starting pay." Like Bronars and Famulari, we deflate by the national average hourly wage.[6]

The resulting estimate of the return to tenure is considerably larger than the point-in-time estimate taken directly from the 1993–94 schedule. Average within-job wage growth for teachers with a bachelor's degree was 60 percent (standard error = 0.38). For teachers who earned a master's degree over the period, wages rose 83 percent (standard error = 0.43). Both are estimates of "real" changes deflated by the growth of nominal average wages over the period. Clearly, these estimates of the return to seniority are affected by upward shifts that occurred in most salary schedules over the period. Merely deflating by average wage growth does not put the starting and ending salary values on a true point-in-time basis. The substantial discrepancy with the point-in-time returns taken from the 1993–94 schedules indicates that wages for teachers (including shifts in the schedule) rose faster over this period than wages of the average worker (though not necessarily faster than wages of other college educated workers).

To summarize, we have found that teachers who have not yet reached the top of their district salary schedule receive raises that are, on average, equivalent in percentage terms to the returns to tenure enjoyed by white-collar workers in general. (For reasons indicated, our estimate of wage growth for new teachers includes raises attendant on a earning a master's degree.) Given the strong likelihood of an upward bias in the estimated returns to tenure in the comparison sample of white-collar workers, it appears that wage-tenure profiles for teachers are, on average, at least as steep as those of other white-collar workers. This is the more striking in that step increments for teachers are a pure return to longevity, independent of promotion and the assumption of additional responsibilities.

We have also found considerable variation in district policy. The estimated standard deviation of returns to tenure among public school districts is equal to the standard deviation among business establishments in the WCP, after controlling for

6. Average Hourly Earnings of Production or Nonsupervisory Workers on Private Nonfarm Payrolls, as reported by the Bureau of Labor Statistics. http://www.bls.gov/webapps/legacy/cesbtab4.htm?H5

two-digit SIC. Moreover, given the substantial upward bias in the standard deviation of the comparison estimates, variation among school districts appears to be greater than the variation in the occupationally heterogeneous comparison sample of white-collar workers.

Finally, we have found a positive relationship between starting pay and step increments among school districts. This is in contrast to a negative correlation between these variables among business establishments. Although the latter appear to be choosing among compensation strategies involving tradeoffs between starting pay and pay growth, such tradeoffs cannot be detected in salaries of public school teachers.

IV. Rationales for the Wage-Tenure Profile

Although wage-tenure profiles appear to be surprisingly steep for public school teachers, it is possible that these schedules represent an efficient response to labor market conditions. If so, districts could not redistribute wages from senior teachers to newer teachers without diminishing the quality of the workforce over the long run. On the other hand, the high returns to tenure in public education may be the result of rent-seeking by senior public employees who use collective bargaining and political activity to tilt the profile in their favor. In this case, it would be possible to redistribute the total wage bill in a manner that would raise the quality of the profession.

We begin by considering three prominent explanations in the labor economics literature for upward sloping wage-tenure profiles.

A. Human Capital Theory

According to human capital theory, pay rises with experience because workers acquire skills and knowledge that make them more valuable to their employers. We have already noted that salary growth for teachers is not, as it often is in other occupations, a consequence of promotion and the assumption of additional responsibilities. However, it might be that experienced teachers receive raises simply because they have become better at teaching. Indeed, teaching is notoriously an occupation in which skills are learned on the job. Thus, rising productivity could explain steep wage-tenure profiles. Districts that fail to pay teachers what they are worth risk losing them to other school systems.

If this explanation were correct, we would expect to see sharply concave wage-tenure profiles, for most of teachers' on-the-job learning is concentrated at the very outset of their careers. The literature on education production functions shows that beyond the first three or four years, additional experience contributes little or nothing to teaching performance (Hanushek 1986).[7] Yet salary schedules commonly reward

7. These estimates may well overstate the relationship between experience and productivity if the least capable teachers leave the profession quickly. If so, an unmeasured selection effect leads to an upward bias in the estimated contribution of experience to output. We are indebted to Steve Rivkin and Eric Hanushek for this observation.

experience at the same proportionate rate through the first 15 to 20 years of service. The human capital explanation also fails to explain why there is so much variation among districts, given that the human capital acquired by new teachers is largely the same regardless of the district employing them.[8]

B. Monitoring Costs

An alternative line of analysis, originating with Lazear (1979, 1981), posits that an upward sloping wage-tenure profile fulfills the function of a performance bond when monitoring of employee performance is costly or imperfect. In these circumstances, the delayed payment of a wage premium elicits higher effort from workers who lose this future reward if caught shirking.

This hypothesis has limited applicability to public school teachers, who enjoy an extraordinary degree of job protection through the institution of tenure. The distinctive problem in public education is not imperfect monitoring. It is the difficulty of dismissing teachers who are *known* to shirk. If the performance bond hypothesis has any relevance, it is presumably for new teachers hired on probationary status. Yet this hypothesis runs into the same difficulty as the human capital explanation. Probation lasts only a few years before teachers are granted tenure. The hypothesis does not explain why most teachers continue to enjoy equally steep returns to longevity 15 or more years into their careers. Moreover, the variation in policy remains a puzzle. Why would the performance bond need to be so much greater in some systems than others?

C. Turnover Costs

A great deal of attention has been paid recently to teacher attrition, which is considered to be especially high in the early years of a career. This suggests that steep salary schedules may be intended to reduce turnover. Salop and Salop (1976) present a model in which costs of turnover to the firm lead it to adopt an upward-sloping wage-tenure profile as a screening device. Workers with a high propensity to quit (which the firm cannot observe directly) self-select out of the applicant pool.

One reason districts are concerned about turnover is the presumed benefit of retaining more productive (because more experienced) teachers. This is simply the human capital hypothesis revisited. If turnover costs per se offer a rationale for a steep wage-tenure profile, it must be on some other basis. Such costs could include the expenses associated with recruiting new teachers and investments in specific human capital.

Notwithstanding the public perception of teaching as a high turnover career, teachers are only slightly more likely to quit their jobs than comparable managerial and professional workers. Using data from successive administrations of the Current Population Survey, Neumark et al. (1999) calculated an N-year retention rate by compar-

8. To the extent that teachers working in different environments (for example, affluent suburbs rather than poor cities) acquire the special skills needed for their jobs at different rates, there might be a role here for human capital theory. But our investigation of the contribution of SES and demographic variables (see Table 3) does not show that the return to tenure varies systematically between affluent and impoverished communities.

Table 2
Estimated Retention Rates for Teachers and Other White-Collar Workers

	Teachers[a]	Teachers	Managerial/ Professional[b]	Clerical[b]	Service[b]
Initial Tenure	3-Year Rate	Imputed 4-year rate	4-Year Rate	4-Year Rate	4-Year Rate
0 - <2 years	0.650	0.533	0.625	0.364	0.257
2 - <9 years	0.729	0.637	0.693	0.536	0.463
9 - <15 years	0.727	0.636	0.854	0.715	0.621
15 + years	0.804	0.739	0.682	0.621	0.495

a. Calculations based on the teacher component of the 1990–91 and 1993–94 Schools and Staffing Surveys.
b. Calculations for 1991–95 using Current Population Survey (Neumark et al. 1999).

ing the number of workers who have spent X years in their current job with the number who replied "X-N years" when asked N years earlier. The ratio furnishes an estimate of the N-year survival rate despite the fact that the data are not longitudinal. Using successive administrations of the Schools and Staffing Survey (SASS), we have followed the same procedure to calculate a retention rate for teachers (see Table 2). Ours is a three-year rate (due to the timing of the SASS); Neumark et al. report a four-year rate. To facilitate comparison, we have imputed a four-year rate for teachers, increasing by one-third the proportion that has quit. This understates the retention rate for the group with zero-one years of initial tenure, who are much more likely to quit near the beginning of a four-year spell than the end. In addition, retention rates for teachers are underestimated because teachers are counted as having quit even if they have gone on temporary leave, something they are much more likely to do than other professionals. Given these sources of downward bias, the differences between teachers and managerial/professional workers do not seem very large.[9]

The nature of teaching raises additional doubts about the magnitude of turnover costs. Turnover is costly when departing workers take with them a lot of specific human capital. One example is the disruption to successful working relationships when team members depart. Another is the cost to the firm when employees leave who have detailed knowledge of the needs of the firm's clients.[10] Neither seems

9. There is a large difference in the 9–15 category, but here the exceptionally high Neumark et al. estimates appear anomalous, possibly an artifact of their estimation procedures. A recent Department of Education study found that occupational turnover among recent college graduates who taught was lower than in 11 of 13 occupations considered. The only occupation with a lower turnover rate was health, and the difference between teachers and health professionals was very small and statistically insignificant (U.S. Department of Education 2001).
10. These are literally textbook examples, both being taken from Ed Lazear's text, *Personnel Economics for Managers*, 1998.

strongly applicable to public school teaching. Most teachers work in isolation from their colleagues. This is not to deny there is a need for teamwork and coordination in schools. (Fifth grade teachers are set back if fourth grade teachers haven't covered the curriculum, and so forth.) But what matters most to the smooth coordination of activities is that teachers perform well the things they do in isolation.

Likewise, every school year teachers start afresh with a new group of clients. This is so whether the teacher has been at the school one year or 20. Thus, on neither of these scores does it appear that turnover is particularly costly to public schools. There are, of course, other types of specific human capital that teachers acquire, including knowledge of the community, the curriculum, and the like. By comparison with other white-collar occupations, however, it is by no means clear that the costs of teacher turnover are high enough to explain why the wage-tenure profile is as steep or steeper in public education as elsewhere. Indeed, given the churning that goes on at the top of school administration, the incessant revisions of the curriculum, and the pursuit of one educational fad after another, it is no exaggeration to say that public schools routinely erase a good deal of the specific human capital that teachers manage to acquire. In such an environment, structuring compensation policies to avoid the costs of teacher turnover would not seem to be an efficient use of resources.

V. Other Determinants of Compensation Policy: Evidence on Rent-Seeking

We turn now to the alternative hypothesis posed above, that observed wage-tenure profiles in public education are the result of rent-seeking by teachers. We begin by exploring models in which the dependent variable is one of several possible measures of the returns to tenure, while the independent variables are district characteristics, including whether teachers engage in collective bargaining.[11]

We construct three measures of the returns to seniority for the large districts in the DOD data set. All three are based on the salary a teacher was scheduled to receive during her fifth year of service in the district during the 1989–90 school year. (This is the interpolated schedule value, as described above.) Academic year 1989–90 was selected to improve comparability with other district-level data from the 1990 Census. The fifth year was chosen as a benchmark because years five to seven mark a career turning point: attrition rates begin to fall dramatically as survivors settle in as career teachers. Our first measure of the return to seniority is the ratio of fifth-year salary to starting salary. In 1989–90, fifth-year teachers with a BA earned on average 16 percent more than starting teachers (Table 5, column 1). The second measure is the ratio of fifth-year pay to the maximum salary a teacher with a BA can earn. A higher value may mean that the wage-tenure profile is not very steep, or it may mean that salary growth is compressed into the first years of a career. On average, we find that fifth-year teachers with a BA earn almost 80 percent as much as a teacher with a BA at the top of the schedule. The third indicator isolates the

11. It appears that few of the white-collar workers in the Bronars and Famulari sample were unionized. The data set used by Bronars and Famulari did not contain union status. However, in their comparison sample from the CPS, fewer than 5 percent of white-collar workers in the same occupations were unionized.

Table 3
Determinants of Returns to Seniority; DOD Large Cities Data

Independent Variables:	Sample Mean (Standard Deviation)	Dependent Variables: 5th-Year Pay ÷ Starting Pay	5th-Year Pay ÷ Maximum Pay	5th-Year ÷ Maximum Growth
Poverty percentage	22.6 (10.3)	0.0036***	0.0027*	0.0079***
		(0.0011)	(0.0016)	(0.0029)
Median household income ($1000)	28.9 (7.5)	0.0026**	0.0059***	0.0145***
		(0.0011)	(0.0016)	(0.0030)
Minority percentage	39.0 (21.3)	−0.0819**	−0.0212	−0.1549*
		(0.0354)	(0.0515)	(0.0941)
Percentage college-educated	23.7 (9.1)	0.0002	0.0012	0.0022
		(0.0006)	(0.0009)	(0.0017)
Collective bargaining	0.72 (0.45)	0.0542***	0.0539***	0.1121***
		(0.0106)	(0.0154)	(0.0282)
Mean (standard deviation) of dependent variable	—	1.16	0.79	0.38
		(0.066)	(0.10)	(0.20)
R-squared	—	0.21	0.21	0.27
Number of districts	—	165	165	165

*** Significant at 1 percent;
** Significant at 5 percent;
* Significant at 10 percent.
Sources of Data: Department of Defense large cities teacher salary survey; Common Core of Data (for 1990 Census of Population variables).

extent of compression by measuring how much of the total salary growth within the schedule a teacher is receiving by the fifth year. The average value is 38 percent. There is substantial variation in each of these measures.

We regress these dependent variables on a variety of district characteristics: the poverty rate among school-age children, median income, the minority share of the population, the percentage of household heads with a college degree (to control for the community taste for education), and a dummy variable indicating whether teachers are represented in collective bargaining. Results appear in Table 3. Included in the equation but not shown are indicators for region. Of the regressors, median income and collective bargaining are by far the most important in terms of their contribution to explained variance. Unions raise the returns to tenure, as seen in Column 1, but they also accelerate them by reducing the number of steps in the schedule (Column 3).

The other regressors were included to determine whether districts that are thought

to have trouble retaining teachers accelerate returns to tenure. The coefficients do not tell a consistent story. More affluent communities tend to compress the schedule, but so do communities with a high percentage of school-age children in poverty. Districts with high minority enrollment are less likely to build high rates of salary growth into the early years of the schedule.

As we noted above, teachers' real wage growth from 1986 to 1997 far exceeded the point-in-time value of step increments. In the DOD sample, the upward shift of schedules accounted for 62 percent of the salary growth enjoyed by teachers starting in 1986 and remaining in the same district to the end of this period. An investigation of these shifts sheds additional light on the factors influencing the returns to seniority.

Unfortunately the number of observations in the DOD sample was not sufficient for this purpose. As an alternative we turned to the three waves of the Schools and Staffing Surveys. While these surveys do not provide the same level of detail on salary policy as the DOD data, they do contain starting pay for a teacher with a BA in each district (*BANEW*) as well as the salary of teachers with an MA and 20 years experience (*MA20*). Using the subset of districts represented in more than one wave of the SASS, we have constructed variables measuring changes in *BANEW* and *MA20*. There are two measures of each change, one between the first and second administrations of the SASS (1988 to 1991) and another between the first and third administrations (1988 to 1994). Changes are measured as a proportion of the 1988 values. A comparatively small number of observations containing suspect values of the salary schedule variables are dropped from the estimation sample.[12]

Explanatory variables include two measures of the financial capacity of the district: median household income and median value of owner-occupied housing from the 1990 Census of Population. Dummy variables for region pick up differences in economic conditions that influenced salary growth.

Previous research into the movement of salary schedules over time has shown that raises are frequently *backloaded:* experienced teachers are given larger raises, both in absolute terms and as a share of previous pay, than beginning teachers (Murnane, Singer, and Willett 1987; Lankford and Wyckoff 1994; Babcock and Engberg 1999). We include two explanatory variables that may predict backloading: union representation in collective bargaining and a proxy for seniority in the district workforce. We also include an interaction between the two, testing whether the composition of the workforce matters in all districts or only where teachers bargain. In the sole previous investigation of the determinants of backloading, Babcock and Engberg (1999) found that median tenure among a district's teachers was a significant predictor of the return to tenure. Because the SASS does not include a direct measure of the composition of the workforce, we use a proxy: the ratio of the average salary earned by the district's teachers in 1987–88, as reported in the district component of the SASS, to the midpoint of the salary range (the average of *BANEW* and *MA20*). The higher the average salary relative to this midpoint, the more teachers who have attained or are approaching the top of the schedule.

12. Close inspection of the data revealed some anomalies and discrepancies likely due to coding errors. Influence diagnostics identified many of these observations as problematic. Accordingly, we discarded observations in which *BANEW* or *MA20* appeared to decline between successive administrations of the SASS, as well as observations in which *BANEW* exceeded *MA20* in the same year. These steps reduced the two estimation samples by 66 and 65 observations, respectively.

As a measure of median tenure, the proxy is obviously imperfect. It does not distinguish between districts in which most teachers are slightly past the midpoint from those in which a smaller number have topped out. The proportion of teachers with advanced degrees also influences average pay. On the other hand, the median voter theorem itself is only an approximation to the internal political dynamic within school districts. Even in districts where the union membership is asked to ratify a contract, teachers do not vote on anything as simple as a district-wide "return to tenure," but rather a schedule that specifies a number of steps and the increments between them for various levels of a teacher's education. Teachers must therefore weigh their immediate economic interests against the likelihood that they will be voting on another contract in a few years' time, when they will occupy a different position on the schedule in a district in which the composition of the workforce will have changed in ways not entirely predictable. In these circumstances, no single measure of the composition of the workforce represents more than a rough indicator of the relative strength of more-experienced versus less-experienced teachers in the salary-setting process.

The salary data in Babcock and Engberg (1999) were contemporaneous with median tenure, raising an obvious question about the direction of causality. Did the characteristics of the workforce shape compensation policy, or had districts offering a high return to tenure been more successful in attracting and retaining a larger number of experienced teachers? Babcock and Engberg dealt with the endogeneity problem by using the degree of community support for unions as an instrumental variable for tenure. Apart from the usual concern about the validity of instruments, this procedure rests on the untested assumption that where the composition of the workforce affects the salary structure, it is through the activity of a strong union. Because all of the Pennsylvania districts used for their study were unionized, this assumption could not be tested directly.

The data from SASS, by contrast, include both union and nonunion districts. We deal with the endogeneity problem by examining changes in salary schedules over time. In these equations the composition of the workforce is a predetermined variable. Our results may not be perfectly free of endogeneity bias if the composition of the 1987–88 workforce reflected correct expectations about which districts were going to backload future pay increases.[13] However, as the 1987–88 workforce was the product of prior employment decisions stretching back many years, bias resulting from this kind of foresight is likely to be quite small.

Two explanatory variables indicate whether the district had trouble meeting its recruiting needs for the 1987–88 school year. One is the percentage of teachers without regular or standard state certification in their main fields of assignment. The other is the percentage of FTE positions that were vacant or filled by a long-term

13. Teachers can, of course, anticipate salary increases that have already been announced. Some shifts in salary schedules between 1987–88 and 1990–91 occurred on the basis of contracts in place in 1987–88. This is less of a concern when examining shifts between 1987–88 and 1993–94, an interval in which virtually all contracts will have been renegotiated. Even in the earlier interval, reverse causality matters only to the extent that the makeup of the 1987–88 workforce was shaped by raises written into the contract in force that year. Given the low wage elasticity of quit rates among midcareer teachers and the limited time in which to respond, substantial influence on work force composition from this source seems unlikely.

Table 4
Shifts in Salary Schedules (Standard errors in parentheses)

Independent Variables	Sample Mean (Standard Deviation)	Dependent Variables: Relative Change in *BANEW* (1987–88 to 1990–91)	*MA20* (1987–88 to 1990–91)	*BANEW* (1987–88 to 1993–94)	*MA20* (1987–88 to 1993–94)
Proxy for district seniority	1.04 (0.11)	0.066**	0.156***	0.077*	0.262***
		(0.035)	(0.054)	(0.045)	(0.060)
Collective bargaining	0.62 (0.49)	0.050	−0.131**	0.068	0.058
		(0.039)	(0.056)	(0.051)	(0.066)
Interaction of seniority and bargaining	0.66 (0.53)	−0.022	0.173***	−0.016	0.020
		(0.039)	(0.055)	(0.050)	(0.065)
Median income ($000)	29.1 (10.3)	0.0004	0.002***	0.001***	0.003
		(0.0003)	(0.0004)	(0.0004)	(0.0004)
Median housing value ($000)	77.9 (52.2)	0.00007	0.00009	−0.0001	−0.0002*
		(0.00006)	(0.00009)	(0.0001)	(0.0001)

1987–88 Starting pay for BA ($000)	17.8 (2.3)	-0.011***	0.017***	-0.017***	0.016***
		(0.001)	(0.002)	(0.002)	(0.002)
1987–88 Pay for MA, experience = 20 ($000)	29.9 (5.6)	0.002***	−0.016***	0.005***	−0.016***
		(0.001)	(0.001)	(0.001)	(0.001)
Proportion of positions vacant/filled by substitutes	0.008	0.03208	−0.018	0.025	0.132*
	(0.037)	(0.04652)	(0.065)	(0.061)	(0.080)
Proportion of noncertified teachers	0.054	0.0161	0.010	−0.011	−0.020
	(0.149)	(0.012)	(0.017)	(0.015)	(0.020)
Mean of dependent variable	—	0.16	0.18	0.26	0.28
Sample size	—	1,438	1,438	1,872	1,872
R-squared	—	0.25	0.38	0.32	0.36

*** Significant at 1 percent;

** Significant at 5 percent;

* Significant at 10 percent. Additional regressors not shown: dummy variables for region. Sources of Data: Schools and Staffing Survey (first three waves); Common Core of Data (for 1990 Census of Population variables); Department of Defense large cities teacher salary survey.

substitute one month into the school year. If recruitment difficulties spur districts to raise teacher pay, we should find positive coefficients on these variables.

Finally, the model includes two variables from the 1987–88 schedules: *BANEW* and *MA20*. These regressors are included for three reasons.

1. Whether *BANEW* or *MA20* increases over time may well depend on how high a district's salaries are at the beginning of the period. Murnane, Singer, and Willett (1987) found evidence of a "catch-up" phenomenon in Michigan school salaries: districts whose pay lagged behind demographically similar districts elsewhere in the state experienced above-average growth in subsequent years. Ehrenberg and Chaykowski (1988) reported similar findings for New York schools.

2. Catchup is likely to occur within a district as well. Districts with high starting pay but low returns to tenure may come under pressure to raise pay for senior teachers on equity grounds.

3. Finally, it is likely that these variables pick up some residual measurement error, despite our efforts to screen bad observations. Measurement error in the 1987–88 values implies regression to the mean in subsequent years and therefore negative coefficients on *BANEW* and *MA20*.

Results appear in Table 4. The proxy for seniority always enters with a positive sign, but is much smaller in the equations for *BANEW* than for *MA20*, just what we would expect if older teachers tilt the wage profile in their own favor. The coefficients on collective bargaining are generally small and insignificant, except for the change in *MA20* from 1987–88 to 1990–91. Collective bargaining does not appear to have been the key mechanism by which senior teachers influenced the slope of salary schedules: the interaction between collective bargaining and teacher seniority is insignificant except, again, for the change in *MA20* between 1987–88 and 1990–91. This may not be as surprising as it first seems. Many districts that do not bargain collectively nonetheless meet with teacher representatives to discuss compensation. Some of them engage in bargaining in everything but name. The resulting agreement is issued in the name of the school board as board policy, but its provisions are negotiated with the union in the same way as union contracts. School boards are also aware that teachers vote in board elections that typically attract a very low turnout from the public at large.

There is evidence of catchup both between and within districts. *BANEW* and *MA20* enter negatively in equations predicting their own change and positively in equations predicting the change in the other. These coefficients are also consistent with regression to the mean resulting from measurement error in the base year. On the other hand, districts that had trouble recruiting do not appear to have responded by raising teacher pay. The coefficients on the employment of non certified teachers are never significant, and the coefficient on the teacher shortage measure is significant only once, in the equation explaining the change in *MA20* from 1987–88 to 1993–94. Thus, the only evidence of a response to teacher shortages was to increase salaries for teachers at the top of the schedule, not for beginning teachers, where such a change would do more to address the problem. Neither measure of district financial capacity appears to have been very important.

The period from the late 1980s through the mid-90s saw a great many educational reforms initiated at the state level. To verify that our results are not due to a relationship between other education reforms and the proportion of senior teachers in a state,

we reestimated the model with state dummies in place of regional indicators. The coefficients on seniority were reduced by about one-third in all four equations and became statistically insignificant in the equations for *BANEW*. However, they remained strongly positive and significant in the equations for *MA20*.

Using data from Michigan districts, Murnane, Singer, and Willett (1986) investigated the hypothesis that in districts experiencing a decline in enrollment, teachers trade off salary increases for job security, creating a positive relationship between changes in enrollment and salary growth. This may not have been an important consideration during 1987–94, when enrollments were climbing in most parts of the country. Nonetheless, one might still expect a positive relationship between salary and enrollment growth, if the demand for teachers in rapidly expanding districts outstripped supply. Including enrollment changes in the model provided no support for either of these hypotheses, however. Coefficients were uniformly insignificant (and sometimes of the wrong sign).

Our failure to find that teacher seniority influences salary growth through collective bargaining might be due to the fact that district size is also a mediating factor. The influence of senior teachers might be particularly strong in small systems where board members are more likely to know teachers personally, especially instructors with many years of service. Thus, in the many small, rural districts that are not unionized, long-standing personal relationships might accomplish what unions achieve elsewhere. To test this hypothesis, district size (measured as the number of full-time equivalent teachers) was introduced into the model both separately and interacted with teacher seniority. Neither of these variables had an appreciable influence on salary growth. Coefficients on the statistically significant regressors were virtually unchanged.

VI. Conclusion

We summarize our main findings in the following six propositions.

1. The wage-tenure profile for public school teachers (until they reach the top of their district schedule) is as steep or steeper than the wage-tenure profile for white-collar workers generally.

2. There appears to be no rationale for steep returns to seniority in terms of human capital or monitoring costs that enjoys both theoretical and empirical support.

3. Although a steeper wage-tenure profile may reduce turnover through employee self-selection, it is doubtful that the costs of turnover are high enough to make this an optimal use of school resources.

4. There is great variation among districts in the return to seniority. However, district financial condition and demographics do not explain which districts reward seniority the most. Demographic and socioeconomic characteristics of the district that plausibly affect recruitment are not systematically related to the slope of the salary schedule. Districts that had trouble recruiting at the beginning of the sample period did not respond by raising beginning salaries relative to salaries paid senior teachers.

5. Collective bargaining has a strong influence on the seniority-wage profile at a point in time. Unions seek both to increase the returns to tenure and to compress

them. This may represent a strategy that preserves union solidarity by offering something to everyone. Senior teachers benefit from backloaded increases in pay. Junior teachers benefit from schedules with fewer steps, allowing them to reach high levels of pay more quickly.

6. The seniority-composition of the workforce has a strong influence on shifts in schedules over time. The more senior the workforce, the more salaries at the top of the schedule have risen relative to beginning teacher pay.

These propositions point to an explanation of teacher compensation based on rent-seeking rather than efficient contracting. In some important respects our measures actually understate the full returns to seniority for public school teachers. Longevity bonuses were not included in the data we examined. Nor have we investigated the relationship between seniority and fringe benefits.

Teacher pensions provide a clear example of a backloaded benefit. In large and medium firms most employees are now covered by defined contribution plans. Nationwide the share of workers covered by defined benefit plans is falling whereas the defined contribution share is rising (Bureau of Labor Statistics, Employee Benefits Survey web site). Defined contribution plans are clearly more attractive for employees who move between employers. However, nearly all public school teachers are covered by state defined-benefit plans. Both the school district and the teacher contribute a fixed percent of income into the plan. In state plans these contributions are vested only after a certain number of years (5–7 years). If a teacher leaves before that time, she loses all of her employer contributions. Since turnover is high in the first few years of teaching, the cross-subsidization favors more senior teachers.[14]

Our conclusion that high returns to tenure for public school teachers are the result of rent-seeking should not be taken to suggest that the only thing at stake is the division of rents among teachers. Because turnover rates are responsive to the slope of the wage-tenure profile, the composition of the teacher workforce is skewed toward older teachers rather than the mix of older and newer employees that maximizes educational output for the dollars spent. It is likely that there are implications for the quality of prospective teachers in the pipeline as well. Given ex ante uncertainty about the length of a teaching career, high salaries in the initial years of a career will have a greater impact on career choices than backloaded raises of equivalent present value. This is all the more true of individuals who are fairly certain they will not be spending their entire working lives as teachers. Yet from their ranks come many of the brightest prospective teachers (Murnane et al. 1991).

Districts whose workforces are dominated by veteran teachers are backloading salary increases at a time when many teachers are nearing retirement and competition for new teachers is intensifying. Although these districts will have an opportunity to reverse course once these veterans have retired and contracts are renegotiated, changes in the seniority-wage profile will occur with a lag. There will be an additional lag before these changes affect the number and quality of new teachers in the professional pipeline. By the time all this occurs (if it does), districts will have al-

14. In Michigan, where private firms are allowed to operate charter schools, many charter schools have opted out of the public school retirement system in favor of 401k plans for their teachers. In interviews with charter school administrators, we have been told that one of the reasons was to compete more effectively for young teachers.

ready replaced many retirees. Under current tenure laws, these recent hires will be firmly entrenched in their jobs where their pursuit of self interest is likely to impede future efforts to upgrade the workforce by reforming teacher personnel practices and compensation.

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