Abstract

While it is generally understood that defined benefit pension systems concentrate benefits on career teachers and impose costs on mobile teachers, there has been very little analysis of the magnitude of these effects. The authors develop a measure of implicit redistribution of pension wealth among teachers at varying ages of separation. Compared with a neutral system, we find that often about half of an entering cohort’s net pension wealth is redistributed to teachers who separate in their fifties from those who separate earlier, and we also identify some variation across six state systems. This implies large costs for interstate mobility. We estimate that teachers who split a thirty-year career between two pension plans often lose over half their net pension wealth compared with teachers who complete a career in a single system. Plan options that permit purchases of service years mitigate few or none of these losses. It is difficult to explain these patterns of costs and benefits on efficiency grounds. More likely explanations include the relative influence of senior versus junior educators in interest group politics and a coordination problem between states.
1. **Introduction**

Traditional teacher pension plans have long been understood to disproportionately concentrate benefits on career teachers and impose costs on mobile teachers. There has, however, been little or no attempt to measure the extent of this implicit redistribution of benefits from short-term to long-term teachers or the costs of mobility for those who cross state lines. Nor has there been a detailed examination of the key features of pension plans that account for these phenomena. In this article we offer the first measurements of the degree of redistribution and mobility costs imposed by typical pension systems and an analysis of plan features that generate them.

In recent years, several developments have made these issues timely. The first has been a heightened demand for teacher quality. This leads directly to questions about whether compensation systems, including pension policy, are designed to optimally attract and retain the highest-quality teachers at any given cost. Second, on the supply side, young educated workers are highly mobile, and there is evidence that job mobility has grown in recent decades (see Jaeger and Stevens 1999; Stewart 2002). If teacher pension systems lack portability and backload benefits more so than other sectors, this may put K–12 employers at a competitive disadvantage in recruiting young college-educated workers.

In addition to these demand and supply factors, another trend, at work for several decades, has been the evolution of teacher pension plans themselves. In general there has been a tendency to reduce pension plans’ normal retirement age and also to expand or enhance early retirement provisions. Since life spans have been increasing at the same time, the span of retirement years widens.

For this and other reasons, teacher pension plans, like other public pension plans, have become more costly. Looking at employer contributions alone, figure 1 (updated from Costrell and Podgursky 2009b) provides evidence of the growing gap between K–12 and private sector benefit costs. Here we report Bureau of Labor Statistics (BLS) quarterly employer retiree benefit costs (including Social Security) for public school teachers and private sector managers/professionals for the period since March 2004 (the first quarter in which the data were released). The chart clearly shows that these costs as a percent of payroll are larger for public schools and the gap is widening. As of this writing (January 2010), the gap still does not reflect the increase

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1. Measuring benefits as a percentage of earnings is the usual convention; reasons for that are discussed in Costrell and Podgursky 2009b (unabridged), pp. 5–6. The percentages can also be converted to dollars using the dollar value of earnings. The dollar benefit gaps between teaching and private sector professionals, however, depend on whether one considers hourly, weekly, or annual compensation (Costrell and Podgursky, 2009b, unabridged, pp. 10–12). The appropriate measure (hourly, weekly, or annual) has been much debated, and this is not the place to revisit those arguments.
in amortization payments that will be required to shore up funding from the drop in asset values since 2007. As states reexamine their pension plans for fiscal reasons, it may also be an opportunity to consider their labor market effects.

In earlier work we focused on the peculiar incentives for retirement built into these systems. Many of these plans feature large spikes in annual pension wealth accrual for teachers in their fifties that act to keep mid-career teachers in the classroom, pulling them to the spike and then pushing them into retirement shortly thereafter as pension wealth accrual turns negative (Costrell and Podgursky 2007a, 2007b, 2009a). In this article, we extend this line of research by focusing on the distribution of these benefits among teachers of varying career lengths and the closely related mobility penalties for those who work a full career but who switch pension systems.

We analyze the distribution of pension wealth by comparing existing defined benefit teacher pension systems with fiscally equivalent systems that would have distributionally neutral accrual paths. Compared with such a system, we find that teacher systems often redistribute about half the net pension wealth of an entering cohort toward those who separate in their mid-fifties from those who leave the system earlier.

This has immediate implications for the costs that teacher pension systems impose on mobile teachers. We are not the first to note that these defined benefit systems impose costs on individuals who separate before normal retirement age or switch systems; a number of policy reports have called attention to this problem (e.g., Gates 1996; Ruppert 2001; Traurig 2001). However, we are unaware of any studies of teacher pensions that undertake a careful analysis of

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Figure 1. Employer Contributions for Retirement and Social Security: Public School Teachers and Private Sector Professionals and Managers. Source: Costrell and Podgursky 2009b, updated. BLS, National Compensation Survey, Employer Costs for Employee Compensation (Various Years)
the accrual of pension wealth over a mobile teacher’s career and how pension plan features affect that accrual process. While it is widely understood that final average salary formulas used in calculating pension annuities produce losses for mobile teachers, it is not widely understood that service eligibility rules for normal and early retirement compound these losses.

The effects of complex pension rules are readily measured by their impact on pension wealth. In this study we examine pension formulas in six state plans and develop measures of the implicit redistribution of pension wealth in these systems from teachers who separate early to those who separate later. We then show how this backloading produces very large losses in pension wealth for mobile teachers. Compared with a teacher who has worked thirty years in a single state system, a teacher who has put in the same years but split them between two systems will often lose well over one-half her net pension wealth. We also show that rules permitting service purchases do very little to ameliorate these losses. We find it difficult to justify on efficiency grounds this system of rewards and penalties that generates such unequal benefits.

2. EMPirical relevance

Before turning to the analytics of teacher pensions, we briefly consider the empirical relevance of this work. The first part of our analysis focuses on the redistributional effects of teacher pension plans, from teachers who have a short teaching spell and exit to teachers who spend twenty-five or thirty years in a single plan. Given the well-documented high turnover rates of younger teachers, the empirical relevance of this analysis is clear.

However, we then go on to consider the mobility costs for teachers who split a full teaching career between two systems. If educator labor markets are local and teachers spend their entire careers within a single state, does it really matter how large mobility penalties in teacher pensions are? It is thus pertinent to ask how extensive interstate mobility is for teachers who pursue full careers in the profession.²

Unfortunately, the data available to answer this question are limited. The best we could find on experienced teacher mobility comes from the Schools and Staffing Surveys. This is not a longitudinal data source, as would be ideal, but respondents were asked about their activities the previous year. The middle column of table 1 reports the percentage of current public school teachers (in 2003–4) who responded that they were teaching in a public school in another state the previous year, by years of teaching experience. These percentages

². A study of New York teachers is widely cited as evidence that teacher labor markets are localized (Boyd et al. 2005). However, this is a study of initial teaching employment and thus is not relevant for this discussion.
Table 1. Rates of Interstate Mobility for Experienced Public School Teachers

<table>
<thead>
<tr>
<th>Years of Teaching Experience</th>
<th>Percent Teaching in Public School in Another State the Previous Year</th>
<th>Simulated Percent of Teaching Cohort Moving during the Indicated Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–5</td>
<td>1.3%</td>
<td>6.3%</td>
</tr>
<tr>
<td>6–10</td>
<td>0.7%</td>
<td>3.2%</td>
</tr>
<tr>
<td>11–20</td>
<td>0.5%</td>
<td>4.7%</td>
</tr>
<tr>
<td>21–30</td>
<td>0.3%</td>
<td>2.7%</td>
</tr>
<tr>
<td>All (0–30)</td>
<td>0.8%</td>
<td>16.9%</td>
</tr>
</tbody>
</table>

Source: Schools and Staffing Surveys; 2003–4 Teacher Survey. Restricted use microdata file. Tabulations by authors.

indicate how many teachers are incurring the costs of mobility each year and do not include the effects of such large penalties on those who are deterred from moving.

With that caveat, we simulated the cumulative cross-state mobility rate for a synthetic cohort of teachers to estimate how many teachers might incur the costs of mobility over the course of a full career. To do so, we take the figures in the middle column as the annual rate of cross-state mobility and assume that no one moves more than once. The results, reported in the last column of table 1, suggest that about one-sixth of teachers might move across state lines sometime during a thirty-year career.3

Further evidence on interstate teacher mobility is found in the 2000 census Public Use Microdata Samples (PUMS). Respondents were asked about their residence five years earlier. We drew a sample of public K–12 teachers aged thirty and older at the time of the 2000 census. These teachers would have been at least twenty-five years old five years earlier and thus most likely out of college. Unfortunately, the PUMS data tell us only the state of residence five years earlier; they do not tell us whether the respondent was employed as a teacher on the earlier date. With this caveat, we found that 5.9 percent of male and 5.1 percent of female teachers lived in another state five years earlier.4

3. Our simulations in table 1 represent the estimated percent of an entering cohort that would have experienced an interstate move by year t of their career. Specifically, the thirty-year figure of 16.9 percent is $1 - (1 - 1.29\%)^5 (1 - 0.69\%)^5 (1 - 0.53\%)^5 (1 - 0.32\%)^5$. Since the annual mobility rates do not include exit from teaching, we may consider this to be an estimate of the cumulative mobility rate for career teachers.

4. For comparison, 7.4 percent of female RNs reported residence in another state five years earlier. While many factors could explain the teacher-RN difference, the vast majority of the RNs (86 percent) are in private sector employment and so are much less likely to be covered by a defined benefit plan as compared with public school teachers, hence less affected by DB mobility penalties. We are unaware of national statistics for DB participation of RNs, but according to BLS data only 21 percent of private health care workers participate in a DB retirement plan (U.S. Department of Labor 2009, table 2).
definition, these rates should be higher than those implied by table 1, since the percentages include those who were in a different state but not teaching, as well as those who were teaching. Using the average rates in table 1 (arithmetic and geometric), we find the comparable five-year mobility figure from the Schools and Staffing Survey (SASS) data to be in the 3–4 percent range. Thus the PUMS data seem consistent with the SASS data, despite the different methods and data sources, possibly lending indirect support to the thirty year figure of one-sixth in table 1.

In sum, we know that many teachers do not pursue full careers in teaching, and of those who do pursue full careers, we have some evidence that a number of them do so in more than one system. We now turn to an examination of how well existing defined benefit plans serve both of these groups.

3. HOW TEACHER PENSIONS WORK

Public school teachers are almost universally covered by traditional defined benefit (DB) pension systems. In such a system, the employer has an obligation to provide a regular retirement check to employees upon their retirement, based on years of service, possibly age, and final average salary.

Typically a DB teacher pension plan requires that both teachers and employers make a contribution each year to a pension trust fund. On average, these contributions are smaller for the majority of teachers who are part of the Social Security system and larger for those who are not covered (Costrell and Podgursky 2009b). Contributions must not only cover the currently accruing liabilities (“normal costs”) but also the amortization of previously accrued unfunded liabilities (“legacy costs”). The salient characteristic of a traditional DB system is that for any individual, benefits are not tied to contributions.

Once a teacher is vested (usually five or ten years; see figure 2), she becomes eligible to receive a pension upon reaching a certain age and/or length of service. Different versions of these eligibility rules are discussed below, but they typically allow a teacher to draw a pension well before age sixty-five, especially if she has been working since her mid-twenties.

Benefits at retirement are usually determined by a formula of the following sort:

\[
\text{Annual benefit} = m \times (\text{YOS} \times \text{Age}) \times \text{YOS} \times \text{FAS}.
\]

In this expression, YOS denotes years of service, the final average salary (FAS) is an average of the last few years of salary (typically three), and \( m \) is a percentage commonly referred to as the multiplier, which may be constant but is often
Figure 2. Years to Vesting in State Teacher Pension Systems. Source: NASRA 2008

a function of service and age. In Missouri, for example, teachers at normal retirement earn 2.5 percent for each year of teaching service. Thus a teacher with thirty years of service would earn 75 percent of the final average salary. So if the FAS were $60,000 she would receive

\[
\text{Annual benefit} = 0.025 \times 30 \times 60,000 = 45,000
\]

payable for life. If the teacher were to separate from service prior to being eligible to receive the pension, the first draw would be deferred and the amount of the pension would be frozen until that time. Once the pension draw begins, there is typically some form of inflation adjustment, although its nature varies from state to state.

Table 2 summarizes some of the key parameters of DB pension plans in six states. While not randomly chosen (we inhabit two of these states), they are indicative of many teacher pension plans. More complete such tables are published by the National Education Association (NEA) and others, showing similar variation in these pension parameters across states (NEA 2004; Loeb and Miller 2007).

The complexity of the formula varies from state to state. Arkansas, for example, has a relatively simple formula. Once an educator reaches age sixty

5. States will often specify a multiplier for “normal” retirement but also have various “early” retirement provisions that can be expressed as age- or service-based reductions in the normal multiplier.

Table 2. Key Features of Selected State Defined Benefit Teacher Pension Plans

<table>
<thead>
<tr>
<th>Feature</th>
<th>Ohio</th>
<th>Arkansas</th>
<th>California</th>
<th>Massachusetts</th>
<th>Missouri</th>
<th>Texas</th>
</tr>
</thead>
<tbody>
<tr>
<td>In Social Security</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Varies by district</td>
</tr>
<tr>
<td>Vesting (years)</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>10</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Retirement eligibility (normal or early)</td>
<td>Normal: Age = 65; or YOS = 30</td>
<td>Normal: Age = 60; or YOS = 28</td>
<td>Normal: Age = 55; or YOS = 30</td>
<td>Normal: Age = 60; or YOS = 30; or Age + YOS = 80</td>
<td>Normal: Age = 65; or Age + YOS = 80 and Age = 60</td>
<td>Normal: Age = 65; or Age + YOS = 80</td>
</tr>
<tr>
<td>Contribution rates</td>
<td>District 14% †</td>
<td>Employer 14% ‡</td>
<td>Employer 8.25% ‡</td>
<td>State 15.6% †</td>
<td>District 12.5%</td>
<td>State 7.98% †</td>
</tr>
<tr>
<td></td>
<td>Teacher 10%</td>
<td>Teacher 6% ‡</td>
<td>State 4.52% ‡</td>
<td>Teacher 11% †</td>
<td>Teacher 12.5%</td>
<td>Teacher 6.9% †</td>
</tr>
<tr>
<td>Multiplier (percent per year of service)</td>
<td>Years 1–30:</td>
<td>Linear segments:</td>
<td>Linear:</td>
<td>Normal, or Age = 55:</td>
<td>2.3%</td>
<td></td>
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<td>---</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>2.2%</td>
<td>2.15% + $900</td>
<td>0.1% at age 41 to 2.5% at age 65</td>
<td>For YOS ≥ 30, add 0.2% to factor, to max of 2.4%</td>
<td>For YOS ≥ 30, add 9% to total</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.5%</td>
<td>For YOS ≥ 30, add 0.2% to factor, to max of 2.4%</td>
<td></td>
<td></td>
<td>For YOS ≥ 30, add 9% to total</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.6%, ...</td>
<td>2.0% at age 60</td>
<td></td>
<td></td>
<td>For YOS ≥ 30, add 9% to total</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>2.4% at age 63</td>
<td></td>
<td></td>
<td>For YOS ≥ 30, add 9% to total</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>For YOS ≥ 30, add 9% to total</td>
<td></td>
<td></td>
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<td></td>
<td>For YOS ≥ 30, add 9% to total</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>For YOS ≥ 30, add 9% to total</td>
<td></td>
</tr>
<tr>
<td>COLA formula</td>
<td>3%, simple</td>
<td>3%, simple</td>
<td>2%, simple, plus floor of 80% initial purchasing power</td>
<td>3%, simple, on first $12,000</td>
<td>CPI, compound, up to 1.80 maximum factor</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>None in statute (periodic, retroactive)</td>
<td></td>
</tr>
</tbody>
</table>

Notes: YOS = years of service; COLA = cost-of-living adjustment; CPI = Consumer Price Index.

aIncludes 1% for retiree health insurance.
bContributory members only. Average is 4.80%, including noncontributory.
cIncludes 2.5% for 80% floor on initial purchasing power (see COLA).
dIncludes 2% for a supplemental defined contribution plan (see CALSTRS 2007).
eCalculated from FY 2007 state appropriation (Commonwealth Actuarial Valuation Report, January 1, 2007).
fFor all teachers hired since 2000.
gIncludes 1.4% for retiree health insurance.
hIncludes 0.5% for retiree health insurance.

or 28 years of service, she can draw a pension equal to final average salary \( \times 2.15\% \) \( \times \) years of service \( (+$900 \) per year\).\footnote{This refers to contributory members. There has also been a noncontributory option that provides lesser benefits. Our analysis of Arkansas pension wealth also excludes a post-retirement re-employment program, T-DROP.} She can start drawing the pension earlier, after twenty-five, twenty-six, or twenty-seven years of service, but with an adjustment of 85 percent, 90 percent, or 95 percent, respectively. The formulas of other states are more complicated, as we shall see below.

The composite effect of these systems, whether they are simple or complex, is hard to discern from the system’s parameters. To appreciate the strong distributional impact of these systems, and thus make informative comparisons among states, we use these parameters to compute patterns of pension wealth accumulation by age of separation.\footnote{Teacher pension formulas are generally similar in structure to those of state employees. In some states the formulas are identical and in other states the eligibility rules favor earlier retirement for teachers. However, public safety workers will typically be eligible for earlier retirement than teachers. Among private sector workers, DB pensions are vanishing. Beginning in the 1980s, many private sector employers shifted to defined contribution (DC) plans. Of those private employers who have maintained DB systems, many have opted for cash balance or hybrid systems. Twenty-five percent of private sector workers covered by DB plans are now cash balance DB plans (more on this below). An example of a hybrid plan is the federal civil service, which replaced its traditional DB plan with a hybrid plan combining a thrift (DC) plan, along with a reduced DB pension. See Hansen 2010; Costrell, Johnson, and Podgursky 2009. In the 1980s, when traditional DB plans were more common in the private sector, they were much studied and the accrual patterns were calculated. In examining this literature, we found that those spikes were dwarfed in size by the teacher pension spikes we have studied, typically by an order of magnitude (Costrell and Podgursky 2009a).}

4. PENSION WEALTH AND CUMULATIVE EARNINGS

The parameters of teacher pension plans can be used to estimate the value of pension benefits using the concept of pension wealth, a measure that reflects both the size of the annual pension payment and the number of years it is received. When an individual retires under a DB plan, he or she is entitled to a stream of payments that has a lump sum value—the present discounted value—that can be readily determined using standard actuarial methods.

Formally, consider an individual’s pension wealth, \( P \), at some potential age of separation, \( A_s \). The stream of expected payments may begin immediately or may (perhaps must) be deferred until some later retirement age. The present value of those payments is:

\[
P(A_s) = \sum_{A \geq A_s} (1 + i)^{(A_s - A)} f(A | A_s) \cdot B(A | A_s),
\]

where \( B(A | A_s) \) is the defined benefit one will receive at age \( A \), (as specified in equation 1), given that one has separated at age \( A_s \), \( f(A | A_s) \) is the conditional probability of survival to that age, and \( i \) is the discount rate.\footnote{The benefit stream may itself be a choice among alternative streams open to the individual, based upon the choice of when to begin receiving payments. Often the best choice is simply to receive the full benefit at age 65 or 67, when the benefit is at its highest level.}

\[
7\text{ This refers to contributory members. There has also been a noncontributory option that provides lesser benefits. Our analysis of Arkansas pension wealth also excludes a post-retirement re-employment program, T-DROP.}
\]
\[
8\text{ Teacher pension formulas are generally similar in structure to those of state employees. In some states the formulas are identical and in other states the eligibility rules favor earlier retirement for teachers. However, public safety workers will typically be eligible for earlier retirement than teachers. Among private sector workers, DB pensions are vanishing. Beginning in the 1980s, many private sector employers shifted to defined contribution (DC) plans. Of those private employers who have maintained DB systems, many have opted for cash balance or hybrid systems. Twenty-five percent of private sector workers covered by DB plans are now cash balance DB plans (more on this below). An example of a hybrid plan is the federal civil service, which replaced its traditional DB plan with a hybrid plan combining a thrift (DC) plan, along with a reduced DB pension. See Hansen 2010; Costrell, Johnson, and Podgursky 2009. In the 1980s, when traditional DB plans were more common in the private sector, they were much studied and the accrual patterns were calculated. In examining this literature, we found that those spikes were dwarfed in size by the teacher pension spikes we have studied, typically by an order of magnitude (Costrell and Podgursky 2009a).}
\]
\[
9\text{ The benefit stream may itself be a choice among alternative streams open to the individual, based upon the choice of when to begin receiving payments. Often the best choice is simply to receive the full benefit at age 65 or 67, when the benefit is at its highest level.}
\]
In principle, $P(A_s)$ represents the market value of the annuity. If, instead of providing a promise to pay annual benefits, the employer were to provide a lump sum of this magnitude upon separation, the employee could buy the same annuity on the market. The teacher’s pension wealth, $P(A_s)$, is the size of the $401(k)$ that would be required to generate the same stream of payments she would be owed upon separation at age $A_s$.

Figure 3 depicts pension wealth, in inflation-adjusted dollars, for a twenty-five-year-old entrant to the Missouri teaching force who works continuously until leaving service at various ages of separation. The salary schedule assumed is that of the state capital (Jefferson City), under which teachers receive annual step increases and also lane increases as they move from a bachelor’s to a master’s degree. The entire salary grid is assumed to increase at 2.5 percent inflation. We assume a 5 percent discount rate $r_{0.05}$ and use the most current female mortality tables (2004) from the Centers for Disease Control and Prevention (CDC). The results are shown for gross pension wealth, given by $P(A_s)$, and net pension wealth, subtracting the cumulative value of employee contributions.

There is a dispute between financial economists and actuaries regarding the prudent discount rate. The 5 percent figure here is closer to the economists’ recommendation than that of the actuaries, who typically use about 8 percent. The higher discount rate will affect the dollar amount for figure 3 (e.g., the gross pension wealth for a teacher separating at age fifty-six drops from $898,000 to $633,000) but will not have much effect on the shapes of the diagrams. It is the shapes that drive our main results, regarding the percentages of pension wealth redistributed by length of career and lost due to mobility.

Most teachers are female. For males, the pension wealth is a bit lower, due to shorter life expectancies, but the curves have very similar shapes.
The accumulation of pension wealth is not smooth and steady but rises with fits and starts, due to rules of eligibility for early retirement and the like. To illustrate with the case of Missouri, after vesting at five years this teacher’s pension wealth grows steadily to age forty-five, reaching about $200,000 in gross pension wealth, representing the present value of a steadily growing annuity collectible at age sixty (see figure 3). The curve gets steeper at age forty-six because Missouri’s “rule of eighty” would allow such a teacher, leaving with twenty-one years of service, to collect her pension for an extra year, starting at age fifty-nine. The rule of eighty continues to add an extra year of pension benefits for each additional year of service up to age forty-nine, at which point the teacher need only defer her pension to age fifty-six. Then there is a big jump at age fifty because her twenty-fifth year of service makes her eligible for an immediate pension (albeit with a reduced multiplier). This adds six years of pension payments to what she had been eligible for at age forty-nine. Growth continues to be rapid in subsequent years as the multiplier is increased to its “normal” rate of 2.5 percent. Following a final bump to the multiplier at thirty-one years of service (age fifty-six), growth in pension wealth slows, and pension wealth net of employee contributions (shown on the lower curve) actually declines. We have gone into this detail to illustrate how the complex pension rules, replete with discontinuities, not only lead to pension wealth curves that are irregularly shaped but, more specifically, bear no resemblance to the smoothly growing cumulative value of contributions.

Cumulative earnings, with accrued interest, evaluated at the age of separation are:

\[ E(A_s) = \sum_{A < A_s} (1 + i)^{(A - A_s)} W(A), \]

where \( W(A) \) is one’s annual wage at age \( A \). Teacher and employer contributions are typically fixed percentages of earnings—call them \( c^t \) and \( c^e \)—so their cumulative values are simply \( c^t \times E(A_s) \) and \( c^e \times E(A_s) \). Net pension wealth, depicted in figure 3, is \( P_{\text{net}}(A_s) = P(A_s) - c^t \times E(A_s) \).

Since pension wealth is the present value of a stream of payments going forward and cumulative earnings is the present value of a stream of payments going backward, both evaluated at the same point in time (at age \( A_s \), they are comparable measures, capitalizing these two components of compensation. Figure 4 depicts gross and net pension wealth as a percentage of cumulative earnings, \( P(A_s)/E(A_s) \) and \( P_{\text{net}}(A_s)/E(A_s) \). The two curves differ simply by the teacher’s contribution rate (12.5 percent in Missouri for FY08, the year depicted). These measures have a fairly intuitive interpretation. Net pension wealth, \( P_{\text{net}}(A_s)/E(A_s) \), expresses deferred compensation as a percent add-on to compensation during one’s working life. Thus an individual separating at
Pension Wealth as Percent of Cumulative Earnings, Missouri Female

Figure 4.

age fifty-three receives gross pension benefits worth 47.8 percent of cumulative earnings, for a net fringe benefit rate of 35.3 percent. Conversely, an individual separating at age thirty would receive gross pension benefits worth only 10.3 percent of cumulative earnings, and negative 2.2 percent net of employee contributions, so this individual (and others up to age thirty-four) would be better off withdrawing her contributions, even though she is vested (that is why, in figure 3 and other figures, we have bounded net pension wealth at zero).

The pension wealth measure \( P(A_t) / E(A_t) \) also has a more concrete interpretation from the funding side. It represents the percentage of earnings that must be set aside each year (from employer and/or employee) in order to fully fund the pension benefits, for any given age of separation.\(^{12}\) Clearly those individuals who retire in their mid- to late fifties receive significantly more in benefits than has been contributed to the system on their behalf (employer contribution is also 12.5 percent), while those who separate from service earlier in their career do not. Figure 4 therefore illustrates the uneven distribution of benefits that is built into the system. In proportionate terms, the net benefits are even more unequally distributed than the gross benefits. We now turn to our measure of the distribution of pension wealth to get a sense of the magnitude of the phenomenon and also to help us compare states.

5. MEASURING THE REDISTRIBUTION OF BENEFITS IN TEACHER RETIREMENT SYSTEMS

We consider the distribution of net pension wealth. As we have seen, teachers separating in their fifties receive greater net pension wealth than those

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\(^{12}\) This does not include contributions required to amortize unfunded liabilities from previous cohorts.
separating earlier, as a percentage of cumulative earnings. To develop a measure of redistribution, we consider a benchmark case where net pension wealth is proportional to cumulative earnings, for comparison with the traditional DB systems. A cash balance (CB) system provides such a benchmark. CB systems calculate employee retirement accounts, based on contributions of employees and employers, with a guaranteed rate of return (usually comparable to the risk-free discount rate recommended by finance economists). Thus pension wealth, both gross and net of employee contributions, is a fixed percentage of cumulative earnings, independent of age of separation. The curves in figure 4 are flat lines under these simple CB systems.

In dollar terms, net pension wealth grows smoothly under such a system, rather than in fits and starts as under many DB plans that exhibit kinks in accrual from age and service eligibility rules. Figure 5 compares the accrual of net pension wealth under Missouri’s DB plan (the S-shaped curve, reproduced from figure 3) with the smooth accrual under a hypothetical CB plan. This diagram readily illustrates the redistribution of net pension wealth toward those who separate in their fifties from those who separate earlier (and from the very few who separate later as well). We now turn to a quantitative measurement of this redistribution.

First we need to define the fiscally equivalent CB plan. To do so, we need to calculate the cost of the DB plan for the cohort of twenty-five-year-old entrants. This requires weights for age of separation. These were estimated from longitudinal teacher-level Missouri data. Using data for the 2002 teaching workforce, we estimated a smooth polynomial function predicting permanent (i.e., at least three consecutive years) exits as a function of age and...
experience. We found that separations of twenty-five-year-old entrants are concentrated in the first years of employment, and then in their fifties.

In addition to using these weights, we must also adjust for the differences in present value of pension wealth evaluated at different ages of separation. Formally, we set $c^e$, the employer contribution rate for the fiscally equivalent CB plan, to satisfy:

$$
(c^e) \cdot \sum_{A_s=25}^{65} g(A_s) E(A_s) \cdot (1 + i)^{-(A_s-25)}
$$

$$
= \sum_{A_s=25}^{65} g(A_s) P_{net}(A_s) \cdot (1 + i)^{-(A_s-25)},
$$

where $P_{net}(A_s)$ and $E(A_s)$ were defined earlier and $g(A_s)$ is the proportion of the cohort that separates at any given age (i.e., the weights discussed above).

The right-hand side is the present value, as of entry age twenty-five, of the average cohort member’s net pension wealth under the DB plan, and the left-hand side is the same concept under the CB plan. Each side is also the present value of the employer’s required contributions under each plan. (Note that this is a “static” fiscal equivalence since we do not factor in any behavioral response in the separation weights to the very different incentives of the two plans.)

Net pension wealth under the actual DB and fiscally equivalent CB plans for a representative teacher in Missouri are shown again in figure 6. To facilitate comparisons across different ages of separation, all dollar amounts are discounted to the entry year of age twenty-five, which is the only difference from figure 5. The DB accrual curve is again S-shaped, while the fiscally equivalent CB curve is approximately straight. In this diagram (unlike figure 5), it is legitimate to compare the gains and losses of those twenty-five-year-old entrants who separate at different ages. Thus, for example, a teacher who separates at age fifty-five would leave with net pension wealth worth roughly $300,000 (at the date of entry) under the DB plan, which is $80,000 greater than her net pension wealth under the fiscally equivalent CB plan. Conversely, a teacher who separates at age forty-five would leave with net pension wealth of $50,000 under the DB plan, which is $100,000 less than the CB plan.

We have developed numerical summary statistics for this analysis. Specifically, we calculate the weighted average of net pension wealth for

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13. We fitted a logit function to individual teacher data with sixth order polynomial terms in age and experience and interactions of age and experience up to quadratic. The fitted values were used as weights in these simulations. Similar results were found with Arkansas data.

14. The curve is actually slightly concave. This is the case when the growth rate of a teacher’s salary is less than the interest rate.
twenty-five-year-old entrants in Missouri to be $114,283, evaluated at entry, representing 24 percent of the weighted average of present value of lifetime earnings.\(^{15}\) Compared with the fiscally equivalent CB plan, an average of $52,360 is redistributed—46 percent of average pension wealth. This represents the average distance between the actual DB and CB curves in figure 6. The losers (comprising 65 percent of the cohort, separating at an average age of 36.6) are transferring an average of $40,299 each to the winners (35 percent of the cohort, separating at an average age of 54.2), who gain an average of $74,726, again evaluated as of entry at age twenty-five.\(^{16}\)

We have made the same calculations of the distributional impact of the DB plans in other states. Table 3 presents summary statistics that provide some basis for rough comparisons. To provide a common yardstick, each state’s summary statistics are calculated using the same set of separation weights (the estimated weights from Missouri) even though, of course, different state pension systems give somewhat different incentives to separate at various ages. It is possible that comparisons among states would be affected by using different state’s set of separation weights.\(^{17}\) For this and other reasons, the comparisons should not be over-interpreted, especially if states are close in any given measure.

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\(^{15}\) Note that this far exceeds the 12.5 percent employer contribution rate in Missouri for FY08, the year depicted (for FY11, the rate is 14.0 percent). The reason is that employer contribution rates are calculated to cover liabilities discounted at 8 percent; our discount rate is 5 percent.

\(^{16}\) The average gain or loss, in absolute value, is \((0.65 \times 40,299) + (0.35 \times 74,726) = 52,360\), our measure of the average redistribution. This is 46 percent of average net pension wealth, $114,283.

\(^{17}\) It may be argued that by using Missouri weights for other states, one underestimates the degree to which teachers in those other states concentrate at the pension spikes and therefore the degree of redistribution. If so, Missouri’s ranking in degree of distribution may be biased upward.
<table>
<thead>
<tr>
<th>State</th>
<th>Average Net Pension Wealth</th>
<th>Average Net Redistribution of Net Pension Wealth</th>
<th>Gainers</th>
<th>Losers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Dollars</td>
<td>Percent of lifetime earnings</td>
<td>Dollars</td>
<td>Share of entrants</td>
</tr>
<tr>
<td>Missouri</td>
<td>$114,283</td>
<td>24%</td>
<td>$52,360</td>
<td>0.35</td>
</tr>
<tr>
<td>Arkansas</td>
<td>$110,911</td>
<td>22%</td>
<td>$43,138</td>
<td>0.34</td>
</tr>
<tr>
<td>Ohio</td>
<td>$112,400</td>
<td>18%</td>
<td>$54,660</td>
<td>0.33</td>
</tr>
<tr>
<td>California</td>
<td>$93,401</td>
<td>15%</td>
<td>$33,461</td>
<td>0.29</td>
</tr>
<tr>
<td>Texas (new hires)</td>
<td>$51,934</td>
<td>10%</td>
<td>$24,336</td>
<td>0.35</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>$51,812</td>
<td>7%</td>
<td>$31,372</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Note: All dollar amounts are present value at entry.
That said, some comparisons might be made. The first pair of columns in Table 3 provides estimates of the relative generosity of employer-funded retirement benefits for twenty-five-year-old entrants, both in dollar terms and as a percent of lifetime earnings. Missouri, Arkansas, Ohio, and California, with average net pension wealth of approximately $100,000 at entry, are about twice as generous as Texas and Massachusetts in dollar terms. As a percent of lifetime earnings, Missouri and Arkansas lead this set of states, at 22–24 percent, while the higher wage states (hence larger denominators) of Ohio and California follow at 15–18 percent. Texas follows at 10 percent (for new hires) and Massachusetts—the highest wage state, with the lowest average net pension wealth—is the least generous, at 7 percent of lifetime earnings.

The variations in relative generosity primarily reflect differences in pension wealth for those who separate in their fifties. They are driven by a few key features of the pension formulas in these states, including the replacement rate and the eligibility rules for first pension draw. The annuity earned at age fifty-five is 65–75 percent of final average salary for the top three states in Table 3 (Missouri, Arkansas, and Ohio) as compared with 48–57 percent for the other three states (California, Massachusetts, and Texas). For all six states, a teacher separating at age fifty-five is eligible for immediate pension (and it is optimal not to defer), but for those separating a bit earlier there is important variation in the age of eligibility or optimality for first draw. For example, upon separating at age fifty, the optimal first draw is immediate in Missouri and Arkansas, which helps explain their relative generosity; for the other states, it is optimal to defer for three to seven years, to ages fifty-three (Massachusetts), fifty-five (Ohio and Texas), or fifty-seven (California).

Our main focus, however, is not the relative generosity but the degree and nature of each state’s redistribution of net pension wealth. Column 3 of Table 3 provides the average dollar amount of redistribution. Column 4 represents this as a percent of average net pension wealth (Column 1). In all states, the degree of redistribution is substantial: 36–61 percent of net pension wealth. In Massachusetts, for example, average pension wealth is low, but most of it is redistributed.
In all states, the average age of separation for winners is in the fifties, although there is some variation (the winners are younger in Missouri and Arkansas than in other states). The average age for losers is usually in the late thirties.\footnote{The weights for calculating the average ages of winners and losers are the total dollar gains and losses by age of separation. Thus, for example, although 26-year-old separators are the most numerous group, their losses are negligible, so they do not weigh heavily in the average age of losers.}

The redistributive gains are concentrated, while the losses are more dispersed, as indicated in columns 5 and 8 of table 3. This is particularly true for Massachusetts, where the gains are concentrated among one-fifth of the cohort. The average gain in pension wealth for the winners (evaluated at age of entry) ranges from $34,601 in Texas to over $80,000 in Massachusetts and Ohio. In all states, the losses are more dispersed, so the average loss is lower, ranging from about $20,000 in California, Texas, and Massachusetts to about $40,000 in Missouri and Ohio.\footnote{We are assuming that early separators withdraw their contributions only if that maximizes net pension wealth. It is likely that some (perhaps many) liquidity-constrained teachers withdraw their contributions even if the net present value of a deferred pension is positive. If that is the case, the redistribution rate from early separators to later separators is larger than we have computed.}

To summarize, there is significant variation among states in the average net pension wealth provided by their DB systems, and also in the magnitude of the gains and losses relative to a distributionally neutral CB system. However, all states redistribute net pension wealth to a substantial degree, to those who separate in their fifties (after about thirty years of service) from those who separate earlier. In addition to the issue of equity, this raises serious concerns for educator mobility, to which we now turn.

6. PENALTIES FOR MOBILITY

It is widely recognized that DB pensions penalize mobility; however, the sources of these costs are rarely delineated or quantified in a systematic way. There are several factors that produce pension wealth loss when a teacher moves. The simplest and most transparent has been termed “non-vested loss.” Teachers who move before they are vested have no claim on a pension, something new teachers easily understand (“If I work five years I get a pension; if I quit before then I don’t”). Upon departure, or shortly thereafter, any teacher contributions are returned with interest (the rate varies and can be well below market), but the teacher does not receive employer contributions.\footnote{South Dakota is an interesting and notable exception. See also the next note.} In general this is a significant source of loss for many young teachers, since most teacher pension systems have a vesting period of five years or longer (figure 2), and the vast majority of early career teacher turnover occurs in the first five years on the job. That said, our simulations below will assume that teachers move...
after vesting, so the mobility loss from not vesting in the first job will not be considered any further.

Even for teachers who are vested, however, there remain potentially large costs from mobility, and these are less transparent. One cost comes from the fact that teacher DB pensions are all based on final average salary (FAS). When a teacher separates before normal retirement age, the value of her annuity is tied to her salary at the time of her separation. No adjustment is made for ensuing real salary growth or inflation. This cost has been termed “deferred pension loss” but is more accurately referred to as “frozen FAS loss.”24

These costs are routinely identified in policy briefs and reports on DB pension systems and seem to be understood in the policy community. However, these same reports imply that this is the only, or at least the predominant, source of loss of pension wealth for mobile vested teachers.25 In fact there are other costs to mobility, arising from the service eligibility rules for normal and early retirement. Teachers who separate from a plan with, say, fewer than twenty years of service will often not be able to begin collecting their pension until much later than teachers who remain in the plan until they meet eligibility requirements. This means that at any given age, pension wealth is lower for the mobile teacher who has left one system early and entered another system late, simply because she can expect to collect fewer pension checks. Alternatively, she may be able to draw her pension at the same time as the teacher who stays in one system, but with a penalty on the multiplier. Either way, as shown below, the costs associated with these eligibility factors are substantial and can account for a significant part of the erosion of pension wealth for a mobile teacher.

Pension wealth calculations such as those in the previous section provide a comprehensive method for evaluating the costs of mobility. The measures of redistribution illustrate the costs incurred by a teacher who separates at an early age versus a later age in the same system. However, in this section we want to consider the loss in pension wealth for a teacher who changes pension systems. Since we will be comparing the pension wealth between movers and stayers who retire at the same age (unlike the previous section’s comparisons), we can revert to calculating wealth as of the date of final separation rather than entry.

Specifically, let us continue to assume that a teacher enters at age twenty-five and works continuously. However, rather than assuming that she works

24. South Dakota is an exception on this point as well. That state inflates final salary at 3.1 percent annually up to the normal retirement age. Although the Social Security system indexes earnings to the date of retirement, we are not aware of any state system besides South Dakota that does so.
25. For example, see Ruppert 2001, a report sponsored by the National Governors Association, the State Higher Education Executive Officers, and the National Conference of State Legislatures.
continuously in the same system, we now assume that at age forty, after fifteen years in state X, she moves to state Y and ultimately separates at age $A_s$. (We consider other scenarios below.) In this section we assume she collects two pensions, one in state X and one in state Y.

Let us also assume that upon reemployment with fifteen years experience, she is placed on step 16 of an identical salary grid in her new district, just as if she had been on that grid from entry. In practice she probably would not be placed that high, and this would constitute another loss from mobility, not only in salary but also in pension (based on final salary), but we leave this aside.

Formally, let $P_{\text{net}}(A; A_e, x)$ denote net pension wealth for a teacher entering in state $x$ at age $A_e$ and separating at age $A$. The net pension wealth for our mobile teacher, serving fifteen years in state X and ultimately leaving state Y at age $A_s > 40$, is $P_{\text{net}}(40; 25, X) + P_{\text{net}}(A_s; 40, Y)$, where both pieces are evaluated as of age $A_e$. Her loss is:

$$\text{loss from leaving state } X = P_{\text{net}}(A_s; 25, X) - \left[ P_{\text{net}}(40; 25, X) + P_{\text{net}}(A_s; 40, Y) \right]$$

$$= \{ P_{\text{net}}(A_s; 25, X) - [ P_{\text{net}}(40; 25, X) + P_{\text{net}}(A_s; 40, X) ] \}$$

$$+ \{ P_{\text{net}}(A_s; 40, X) - P_{\text{net}}(A_s; 40, Y) \}.$$  \(5\)

The second term in braces represents the difference in pension generosity between the two systems for teachers spending the latter part of their career in state Y versus state X.\(^\text{26}\) This can be positive or negative due to differences in pension formulas. The first term in braces is the pure mobility cost for state X, and that is what we focus on.

The pure mobility cost for state X can be thought of as the loss from leaving state X and then reentering an identical state, with the same pension formula and same pay grid but with zero creditable service. It is important to note that in a CB system of the type described earlier, the mobility cost is zero. That is because the present value of lifetime earnings is the same under either career path (again assuming no loss in steps upon moving). Therefore, the CB wealth—a fixed percentage of lifetime earnings—is also unaffected by mobility. But as we saw in the previous section, the DB wealth trajectory differs markedly from that of the fiscally equivalent CB plan, redistributing

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\(^\text{26}\) A similar calculation for the loss from entering state X from state Y, compared with a full career in state X, results in the same expression, except the generosity differential is based on the first years of her career.
from early separators to stayers. This inequality is closely related to the cost of mobility.

The hypothetical net wealth trajectory described above—leaving state X and reentering with zero service—is illustrated in figure 7 for Missouri. The solid curves depict net pension wealth under the DB and fiscally equivalent CB plans, evaluated at date of separation, reproducing figure 5. The dotted curves represent the wealth trajectories for those who move after fifteen years, at age forty. For the CB plan, the mover’s wealth trajectory lies on top of the stayer’s, and there is no loss from mobility.

For the DB plan, however, the paths diverge in year sixteen at age forty-one and thereafter. The dotted line is the sum of net pension wealth from the two pensions. For the first five years, the dotted line is flat because the teacher is not yet vested in the new system. The difference here between the solid and dotted lines is the vesting loss discussed above in the second job. However, the loss does not vanish but continues to widen in the years immediately following vesting. The stayer’s wealth trajectory accelerates at certain points, due to the rule of eighty and the “twenty-five-and-out” provision, which advance the first pension draw. The mover, however, enjoys no such acceleration—her accrual is relatively smooth—because she never meets the eligibility requirements for retiring before age sixty.

Specifically, under a continuous career she would obtain thirty years of service by age fifty-five, qualifying her for normal retirement benefits immediately at 75 percent of final average salary. This is worth $626,088 (inflation adjusted) at age fifty-five. Under the broken career, the teacher receives two annuities, each of which is for 37.5 percent of final average salary, but the
FAS for the first pension is of course much lower. This is the frozen FAS loss described above. In addition, neither the first nor the second pension would be drawn until normal retirement at age sixty; early retirement options are available, but the penalties in this case favor deferral. This means that five years of pension payments are lost (along with the inflation adjustments for those years). These two factors together reduce the net pension wealth to $219,163, a loss from mobility of $406,925, evaluated at age fifty-five. This is the gap between the dotted and solid curves in figure 7 at age fifty-five. The cost of mobility is 65 percent of net pension wealth.27

Note that for later separation ages, the mobility loss from delayed first draw diminishes because the stayer is forgoing pension payments herself. If she stays to age sixty, there is no difference in the timing of pension checks between her and her mobile alter ego. For final separation beyond age sixty, the mobile teacher actually has an advantage on the first pension, since that can still be collected at age sixty. This contributes to the narrowing of the gap between the dotted and solid DB curves.28

Figures 8–12 similarly depict the costs of mobility for our five other states. Table 4 provides summary calculations of these mobility losses for all six states.

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27. For gross pension wealth, the loss is identical in dollars but lower in percent—47 percent in this case.

28. Indeed, in the case of Massachusetts, those who separate at age sixty-five fare less well as stayers than as movers, as shown in figure 12. For movers, the first pension would be optimally collected starting at age fifty-five, a full ten years earlier than for stayers, which outweighs the fact that the first pension’s FAS is smaller. There is another advantage to splitting up the pension in Massachusetts, due to the nature of the cost of living allowance (COLA).
Again, these are pension wealth losses for a twenty-five-year old entrant who spends her first fifteen years on another (but similar) teaching job. Consider the entries for Missouri. The first two columns give the dollar loss from mobility for a fifty-five-year-old separator, evaluated at age fifty-five (as depicted in figure 7), and evaluated at entry (for comparison with the previous section). Either way, the mover suffers a loss of 65 percent of her pension wealth as compared with the stayer. A glance down the third column shows substantial mobility costs in all six states, ranging from 41 percent to 74 percent. The next three columns indicate the age of first pension draw for fifty-five-year-old
Robert M. Costrell and Michael Podgursky

Figure 11. Net Pension Wealth, TX (New Hires): Movers vs. Stayers. 73% Loss from Mobility for Age 55 Separator: $197K

Figure 12. Net Pension Wealth, MA: Movers vs. Stayers. 58% Loss from Mobility for Age 55 Separator: $195K

separators; for stayers it is immediate, but for movers it is deferred on both pensions, except for Massachusetts.

The last two columns compute the weighted average loss over all teachers who separate after the age of fifty (as opposed to just those at fifty-five).29 Again, the losses for the mobile teacher are substantial, ranging from 36 percent to 67 percent. Overall, the average loss from mobility is roughly half the net pension wealth of stayers.

29. Again, the weights are those of Missouri. Note also that the dollar losses cannot be calculated at exit because we are averaging over different exit years. So they are evaluated at the common entry age.
### Table 4. Losses from Mobility: 25-Year-Old Entrants, 15 Years in First Job

<table>
<thead>
<tr>
<th>State</th>
<th>Dollar loss of pension wealth, evaluated at 55</th>
<th>Dollar loss of pension wealth, evaluated at entry</th>
<th>Loss as percent of Stayers' pension wealth</th>
<th>First draw: Movers, 1st pension</th>
<th>First draw: Movers, 2nd pension</th>
<th>Average Separator over 50: Loss from Mobility vs. DB Stayers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missouri</td>
<td>$406,925</td>
<td>$197,493</td>
<td>65%</td>
<td>55</td>
<td>60</td>
<td>$180,731</td>
</tr>
<tr>
<td>Arkansas</td>
<td>$312,335</td>
<td>$151,586</td>
<td>54%</td>
<td>55</td>
<td>60</td>
<td>$138,074</td>
</tr>
<tr>
<td>Ohio</td>
<td>$522,865</td>
<td>$253,762</td>
<td>74%</td>
<td>55</td>
<td>60</td>
<td>$194,933</td>
</tr>
<tr>
<td>California</td>
<td>$201,409</td>
<td>$97,750</td>
<td>41%</td>
<td>55</td>
<td>57</td>
<td>$80,779</td>
</tr>
<tr>
<td>Texas (new hires)</td>
<td>$197,220</td>
<td>$95,717</td>
<td>73%</td>
<td>55</td>
<td>63</td>
<td>$85,002</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>$194,627</td>
<td>$94,458</td>
<td>58%</td>
<td>55</td>
<td>55</td>
<td>$62,416</td>
</tr>
</tbody>
</table>

**Average Separator over 50:** Loss from Mobility vs. DB Stayers
Finally, consider figure 13, which decomposes the mobility loss in each of the six states for fifty-five-year-old separators who split their career. For each state, the full bar depicts the net pension wealth for a teacher who stays in a single state system. The bottom bar, in dark gray, depicts the net pension wealth for the teacher who moves. The other bars, representing the difference between the two, depict the losses from mobility, decomposed by source.

For Missouri, 59 percent of the loss is due to the delayed first draw (black bar), and 41 percent is from the frozen FAS (light gray bar). Mobility costs in Arkansas break down similarly, 64–36 percent. In Ohio, the mobile teacher optimally defers first draw to age sixty, but still incurs an early retirement penalty (a lower replacement rate, reducing the pension as a percent of FAS) due to lack of service. Taken together, these losses from eligibility rules (the black and white bars) account for 70 percent of the mobility loss, and 30 percent is from frozen FAS. In California and Texas, the mobile teacher optimally defers the first draw, but this raises the replacement rate, partially offsetting the mobility loss (so the white bar is in negative territory). Finally, in Massachusetts, the mobile worker does not defer the pension beyond fifty-five, but

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30. The losses from each source taken separately overexplain the mobility loss, so the offsetting interaction term is allocated proportionately in these calculations.

31. The portion attributable to frozen FAS is somewhat sensitive to the assumed rate of inflation but not as much as one might expect on these simulations. For example, using a 4 percent rate of inflation instead of 2.5 percent, the share of Arkansas’s mobility loss attributable to frozen FAS goes from 36 percent to 44 percent, and for Ohio that share goes from 41 percent to 47 percent. Conversely, note that even if inflation were zero, there would still be a loss from failure of FAS to rise along the salary grid.
Table 5. Losses from Mobility, by Age of Move: 25-Year-Old Entrants

<table>
<thead>
<tr>
<th>Age of Move</th>
<th>MO</th>
<th>AR</th>
<th>OH</th>
<th>CA</th>
<th>TX</th>
<th>MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move at age 30</td>
<td>$103,629</td>
<td>$171,436</td>
<td>$325,119</td>
<td>$142,902</td>
<td>$41,191</td>
<td>$165,359</td>
</tr>
<tr>
<td>Move at age 35</td>
<td>$382,152</td>
<td>$302,756</td>
<td>$512,869</td>
<td>$199,585</td>
<td>$101,863</td>
<td>$181,455</td>
</tr>
<tr>
<td>Move at age 40</td>
<td>$406,925</td>
<td>$312,335</td>
<td>$522,865</td>
<td>$201,409</td>
<td>$197,220</td>
<td>$194,627</td>
</tr>
<tr>
<td>Move at age 45</td>
<td>$403,286</td>
<td>$295,605</td>
<td>$518,967</td>
<td>$194,691</td>
<td>$144,596</td>
<td>$187,742</td>
</tr>
<tr>
<td>Move at age 50</td>
<td>$29,943</td>
<td>$(1,375)</td>
<td>$374,435</td>
<td>$139,454</td>
<td>$82,701</td>
<td>$229,885</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age of Move</th>
<th>MO</th>
<th>AR</th>
<th>OH</th>
<th>CA</th>
<th>TX</th>
<th>MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Move at age 30</td>
<td>17%</td>
<td>29%</td>
<td>46%</td>
<td>29%</td>
<td>15%</td>
<td>49%</td>
</tr>
<tr>
<td>Move at age 35</td>
<td>61%</td>
<td>52%</td>
<td>72%</td>
<td>41%</td>
<td>38%</td>
<td>54%</td>
</tr>
<tr>
<td>Move at age 40</td>
<td>65%</td>
<td>54%</td>
<td>74%</td>
<td>41%</td>
<td>73%</td>
<td>58%</td>
</tr>
<tr>
<td>Move at age 45</td>
<td>64%</td>
<td>51%</td>
<td>73%</td>
<td>40%</td>
<td>54%</td>
<td>56%</td>
</tr>
<tr>
<td>Move at age 50</td>
<td>5%</td>
<td>0%</td>
<td>53%</td>
<td>28%</td>
<td>31%</td>
<td>68%</td>
</tr>
</tbody>
</table>

she forgoes the pension enhancement for thirty years of service that was enacted in 2000, a penalty for mobility that outweighs the frozen FAS. All in all, the service eligibility rules for early retirement, pension bumps, and the like (little known to the general public and, we suspect, to many young teachers) can impose large costs on teachers who move.

**Mobility Loss by Age of Move**

We have examined the full array of scenarios for a twenty-five-year old entrant splitting a thirty-year career, with moves at thirty, thirty-five, forty (the scenario above), forty-five, and fifty, to gauge the sensitivity of our findings. The results are presented in table 5. The top two panels show the loss evaluated at age fifty-five, in dollar terms and as a percentage of stayers’ wealth. The bottom panel shows the percentage loss averaged over all separations beyond age fifty. Each panel clearly shows that for all states except Texas, the pension loss is almost as large for moving at ages thirty-five or forty-five as it is for the move at forty.32

32. For Texas, having twenty years of service in either the first or second job (accrued by moving at forty-five or thirty-five, respectively), allows one to draw the pension at age sixty without penalty.
Figure 14 illustrates the case of Missouri. The top curve is the stayer’s pension wealth and the four other curves represent wealth accrual for those who move at ages thirty, thirty-five, forty, and forty-five. The latter three curves indicate no appreciable difference in pension wealth at 55 for those who move at ages 35–45.

The pension loss is typically much smaller if one moves early, at age thirty, since twenty-five years in the second job will often suffice to secure an immediate pension at age fifty-five, eliminating much of the loss. Conversely, late career moves, at age fifty, can also reduce the pension loss, for the same reason, because twenty-five years on the first job will often allow one to draw the first pension at age fifty-five or even at fifty. Indeed, in some states, if one is willing to work a few years beyond fifty-five on the second job, one can do significantly better than staying a full career in one system. As figure 15 shows, for Missouri such a move can allow pension wealth to continue accruing after accrual turns negative for the stayer.

**Purchasing Service Years**

In theory, the large mobility costs we have calculated could be ameliorated if agreements could be reached for reciprocity regarding service years between the systems. While there have been discussions of developing such reciprocity under the rule of eighty. This is notably better than one can do with only fifteen years in each job (accrued by moving at forty), so the loss from mobility is notably lower by moving at thirty-five or forty-five in Texas.

33. Massachusetts is the main exception among our six states. That is because the main loss from moving at forty is the failure to secure the thirty-year bump, and that is still true for those who move at age thirty.
agreements, to date we are aware of no two states where this exists.\textsuperscript{34} Given the variation between states in benefit formulas and teacher contribution rates, undoubtedly there is concern about ensuring even exchanges of net benefits. There is no guarantee that the flows between two states would be balanced—teachers might start their careers in Maine and end them in Florida. The fact that teachers in some states are covered by Social Security while others are not further complicates matters. In addition to these difficulties, commentators have noted that teacher pension boards tend to be dominated by long-term employees or pension recipients, so the problems of short-term, mobile teachers have traditionally received less attention (Gates 1996).\textsuperscript{35}

Given the failure to develop interstate reciprocity agreements, it is sometimes claimed that the mobility problem is partly ameliorated by rules permitting the purchase of service credits by mobile teachers (Gates 1996; Ruppert 2001). When a vested teacher terminates membership in a pension system, she has the option of withdrawing her contributions. For example, in Texas teachers who withdraw from the system can take their contributions plus 5 percent annual interest. Most states allow experienced teachers who transfer in to purchase service years for prior experience, up to a limit—usually the minimum of prior service years or years in the current system. Thus a teacher

\textsuperscript{34} In some states, reciprocity agreements do exist among systems managed by the state—e.g., between state employees and teacher pensions in Missouri. However, they do not exist between teacher pension funds across state lines. Even in regions with considerable teacher and administrator mobility, such as New England, there has been no development of interstate reciprocity in educator retirement systems.

\textsuperscript{35} Interest in the topic seems to have peaked with the previous bull market in equities (Ruppert 2001; Traurig 2001). We could find little discussion of such reforms since.
Table 6. Maximum Service Years a Mobile California Teacher Can Purchase by Withdrawing Her Pension System Contributions

<table>
<thead>
<tr>
<th>40-Year-Old Teacher with 15 Years Experience in CA Employed at Step 16 in:</th>
<th>Years Purchased</th>
</tr>
</thead>
<tbody>
<tr>
<td>Missouri</td>
<td>2.8</td>
</tr>
<tr>
<td>Texas</td>
<td>3.8</td>
</tr>
<tr>
<td>Arkansas</td>
<td>3.4</td>
</tr>
<tr>
<td>Florida</td>
<td>3.7</td>
</tr>
</tbody>
</table>

Notes: A California teacher employed in the Sacramento school district who contributes 6% annually to the state teacher retirement fund takes a job in the indicated state earning the inflation-adjusted salary she would have earned at step 16 on the Sacramento schedule. She withdraws her contributions (plus 5.25% interest) and purchases the maximum number of service years those funds permit in the new pension system.

with ten years of Missouri public school teaching experience who moves to Texas can purchase a year of experience for every year of Texas service, up to a maximum of ten. Arkansas, Florida, and Ohio will permit no more than five years of purchases, regardless of the number of years of prior out-of-state experience.

The rules for these purchases can be complicated. However, most systems charge prices that reflect the actuarial cost of service years, either averaged over all teachers or customized for the teacher in question. Examples of the former are Arkansas, Missouri, and Florida, which charge the teacher the same rate as the combined employer and employee contributions for the year in which she makes the purchase. This rate, of course, reflects the normal actuarial costs plus amortization of unfunded liabilities for the entire system (not just the teacher in question). Other states, such as Texas and California, charge the mobile teacher an actuarial rate based upon the age of the teacher making the purchase. In this case, the rate is lower for young teachers and rises with age.

However, in either case the funds the teacher has available from cashing out of her old system typically fall far short of what is necessary to purchase the same number of years in the new system or maintain equivalent pension wealth. The reason for this shortfall is that a teacher typically receives on cashing out of her pension plan her contributions only, with some rate of annual interest. Teacher contributions are usually no more than one half of total contributions, as indicated in table 2. Teachers in states with low teacher contribution rates are in general not going to be able to repurchase most of their service years when they change systems.

This point is illustrated in table 6 for a hypothetical teacher moving from California to teach in another state. Again we assume that our representative
Table 7. Hypothetical Purchase of Service (POS) Calculations: Entry at 25, 15 Years to First Pension vs. POS for Second Pension, Collected at 55

<table>
<thead>
<tr>
<th>Gross PW for 1st Pension</th>
<th>Increment to PW for 2nd pension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>3-year POS</td>
</tr>
<tr>
<td>Missouri</td>
<td>$162,325</td>
</tr>
<tr>
<td>Arkansas</td>
<td>$149,707</td>
</tr>
<tr>
<td>Ohio</td>
<td>$163,879</td>
</tr>
<tr>
<td>California</td>
<td>$163,748</td>
</tr>
<tr>
<td>Texas (new hires)</td>
<td>$70,617</td>
</tr>
<tr>
<td>Massachusetts</td>
<td>$190,864</td>
</tr>
</tbody>
</table>

Note: All dollar amounts are inflation adjusted and evaluated at age 55. PW = pension wealth.

teacher enters at age twenty-five and teaches continuously. In this case we assume that she has taught for fifteen years in the Sacramento school district and is thus vested in the California teacher retirement system. When she moves she has the option of leaving the California system and withdrawing her contributions along with compound interest of 5.25 percent. Netting out inflation, fifteen years of her contributions would give her a real balance of $44,296. Assuming that she moved on to a teaching job paying what she would have earned had she stayed in Sacramento (again, net of inflation), how many years of teaching service could she buy in these systems? In no case can she come close to purchasing fifteen years. The best she can manage is between 2.8 and 3.8 years in the new system.

Indeed, the service she can purchase is not only far below what is needed to match the stayer’s pension wealth, it is usually not even sufficient to match the two-pension option modeled above. Table 7 provides the relevant calculations for the case of our mobile teacher who moves at fifteen years and then separates after thirty years, at age fifty-five. If she cashes out from the first system and buys service in the second system, she forgoes the first system’s pension and enhances the second. Forgoing the first system’s pension means she loses the gross pension wealth. This figure is reported in column 1 for each of our six states, evaluated as of age fifty-five. The next three columns show the gain in pension wealth (again, at age fifty-five) from purchasing three, four, or five years of service in the second system. Thus a teacher who cashes out of her first state pension loses column 1 and in most cases gains one of the values in columns 2–4. With the exception of Texas rules (for new teachers), cashing out is always a losing proposition. The teacher is better off keeping her funds in the old system. Thus the mobility losses we showed in the 15–15 example of
a previous section would almost certainly be larger if the teacher cashed out of the first pension system.36

7. CONCLUSION
This article contributes to the teacher quality and compensation literature by analyzing the distribution of net pension benefits among teachers of varying ages of separation and the corresponding costs that teacher pension systems impose on mobile teachers. We are not the first to note that these defined benefit systems impose costs on individuals who separate before normal retirement age or switch systems. However, we are unaware of any studies of teacher pensions that estimate the patterns of such costs, and the reasons for them, through analysis of the accrual of pension wealth at varying ages of separation, and the pension plan rules that govern that process.

We examined pension wealth accrual in six state plans and developed measures of the unequal distribution of benefits. Compared with a distributionally neutral system, we find that typically about half an entering cohort’s net pension wealth is redistributed to teachers who separate in their fifties from those who separate earlier. One of the main reasons for this is that teachers who remain into their fifties can start collecting their pension immediately, while teachers who separate earlier often must defer their pension (e.g., to age sixty), so they collect fewer payments over their retirement.

We showed how this inequality in benefits produces very large losses in pension wealth for mobile teachers. We estimate that teachers who split a thirty-year career between two pension plans often lose over half their net pension wealth compared with teachers who complete a career in a single system. This result is robust with regard to whether the move is made at ten, fifteen, or twenty years, and in some states the loss is also large even for moves as early as five years. Again, one of the main reasons for this loss is that teachers who split their career often cannot begin collecting pension payments as early as those who stay in one system. We also show that rules permitting service purchases do very little to ameliorate the loss from mobility.

Our discussion has focused on teachers. However, the problems we have identified generalize to other professional staff in public schools. Indeed, to the extent that markets extend beyond state borders for any K–12 professionals,

36. Unfortunately we are aware of no national compilation of service year purchases by mobile teachers. These data are not routinely reported in pension fund annual reports. To get a sense of the magnitude of service year purchases for out-of-state teaching experience, we requested data on these purchases from the Missouri teacher pension fund (Public School Retirement System; PSRS). During the 2007 fiscal year, the most recent data available, 210 PSRS members (teachers as well as administrators) purchased 550 out-of-state service credits. This is in a system with an active membership of roughly 78,000 educators.
the problem arises. School administrators are always included in teacher retirement systems, and increasingly their market is becoming regional or national in scope. For example, even modest-sized school districts routinely advertise vacancies for principals and superintendents regionally or nationally and hire national consulting firms to conduct these searches. A visit to the national Web sites of professional associations or perusal of their national publications finds many advertisements for vacancies. Yet for mobile administrators, retirement benefit systems with five- to ten-year vesting can have a devastating effect on retirement benefits, a fact that has not escaped the notice of some school administrators (Chion-Kenney 1999; Wilson 2001).

The impediments to mobility, for both teachers and administrators, may be particularly problematic for charter schools. Currently just over one million students are enrolled in charter schools. Many of these schools are part of organizations (e.g., KIPP Academies, Edison, Imagine Schools) operating in more than one state. Edison Learning, for example, operates schools in sixteen states. As these schools attempt to replicate their school models, it is valuable to them to move staff from one location to another, particularly when starting up new schools, in much the same way business firms relocate managers. As we have shown, these educator benefit systems can make this very costly in states where charter employees are required to join the state pension system.

We find it difficult to justify such a system of rewards and penalties on efficiency grounds. To take one final example, consider the large differences in the growth of public school enrollment between states. Figure 16 reports National Center for Education Statistics (NCES) projections of the growth of public school K–12 enrollment between 2005 and 2017 in the fastest- and slowest-growing states. On one hand, states such as Nevada and Arizona are forecast to have enrollment growth in excess of 40 percent over this period. At the same time, Louisiana, Vermont, and Rhode Island can expect declines

37. Ironically, these features of pension systems can actually raise the already high level of retirement benefit costs. In the current school year in Missouri, the combined contribution rate for retirement benefits is 28 percent with no salary cap, yet examination of Missouri superintendent contracts finds many that provide additional funds, over and above these mandatory contributions, to purchase retirement annuities for mobile (or potentially mobile) superintendents.

38. There is an economics literature analyzing pensions as efficient market responses (e.g., Lazear 1986). However, the key features in these models that make pensions efficient labor market contracts—efficiency wages or firm-specific human capital—seem irrelevant in the K–12 context. The first type of model, efficiency wages, argues that the prospect of a pension keeps workers from shirking, for fear of dismissal. However, by the time public school teachers are vested in their pension systems they are tenured in their jobs. Dismissal for shirking is simply not an option for most employers. Second, pension models grounded in firm-specific human capital investments are irrelevant because, in the case of teacher pensions, the “firm” is the entire state. Teachers are free to take their pension benefits, and their human capital, to thousands of schools within the state pension plan. It might be argued that teacher pension systems, by impeding interstate mobility, prevent the efficiency loss of state-specific human capital, but it seems unlikely that such state-specificity is very strong.
Robert M. Costrell and Michael Podgursky


of 10 percent or more. Heavily populated states such as Michigan and New York can expect declines of between 5 and 6 percent. In a well-functioning labor market, one would expect to see mobility of teachers from declining to expanding teacher labor markets. Instead the pension system tends to lock public school teachers into labor markets in which their skills are in declining demand by imposing large costs on those who move.

The barriers to reform most likely lie in classical political economy. First, states have a coordination problem. It is in no state’s individual interest to facilitate mobility out of the state; each state would like to keep its labor supply large and retain the products of its teacher education programs. Thus states are inclined to keep average pension costs low by skimping on benefits for those who depart. Furthermore, even if states wanted to facilitate mobility, it is difficult to break out of a backloaded system. If an individual leaves state X with fifteen years of service and a pension worth $100,000, the state could in principle transfer the $100,000 to the teacher’s new state Y for fifteen years of credit in that state. However, those years of credit would typically raise the value of the pension in state Y by far more than $100,000, due to service-based eligibility rules for early retirement. So state Y would not accept $100,000 as the price for granting fifteen years of service credit, and state X would not offer more than $100,000.39

39. We note once again that this market failure would not occur if states X and Y had smooth accrual of pension wealth as in the cash balance benchmark we have used. In this case, the additional pension wealth provided to the teacher in her new state (Y) would simply be the $100,000 paid by state X. She would suffer no loss, and neither would state Y.
In addition to coordination problems between states, the distribution of benefits within states between short and long termers will be governed by the relative influence of junior versus senior educators in educator groups and state politics. Influence generally increases with seniority for a variety of reasons, and these are enhanced in the case of pension politics because the benefits of pensions are far more immediate and tangible for senior educators than for junior ones. This is especially true given the opaque nature of FAS DB systems with complicated eligibility rules.

All that said, these barriers are not insurmountable. Similar issues arise in higher education, yet the benefits of academic mobility have led many state and private universities to offer more portable retirement plans. We believe that as states grapple with the pension difficulties they now face, they should take the opportunity to consider systems with smooth wealth accrual such as the CB plan modeled in this article. Another alternative to consider might be a hybrid, such as TIAA-CREF, which has features of both CB and DC that have proven so popular in higher education. Such systems are more transparent, tie benefits more closely to contributions, and do not penalize mobility or job shopping among young teachers. More generally, education policy makers should at least consider experiments that provide actuarially fair alternatives to traditional DB plans for new teaching recruits and evaluate their utility in recruitment and retention of high-quality teachers.

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REFERENCES


This in fact seems to have been an important element in South Dakota’s unusually portable pension system for K–12. South Dakota, a small state, merged its various pension systems some years ago, and to maintain satisfaction among its higher education members, portability features were extended to all.


