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Efficiency and Equity in the Time Pattern of Teacher Pension Benefits

An Analysis of Four State Systems

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EFFICIENCY AND EQUITY IN THE TIME PATTERN OF TEACHER PENSION BENEFITS: AN ANALYSIS OF FOUR STATE SYSTEMS

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Abstract:

Defined Benefit pension plans often generate odd time patterns of benefits. One typical pattern exhibits low accrual in early years, accelerating in mid-late years, followed by dramatic decline, or even negative returns in years that are relatively young for retirement. We consider four states for specific analysis: Arkansas, Missouri, California and Massachusetts. There are interesting variations among these states' formulas, which affect the incentive to retire early. We identify key factors in the defined benefit formulas that drive such patterns and likely consequences for employee behavior. We examine the efficiency and equity consequences of these systems and lessons that might be drawn for pension reform.

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1. Introduction

Teacher pensions have long been an important part of compensation. Traditionally, it has been argued, current compensation has been relatively low for public employees, but pension benefits have been relatively high. This mix was typically rationalized by the contention that the public good was best served by the longevity of service that would be induced by defined benefit plans.[1] In recent decades, however, evidence is growing that many such plans, by encouraging early retirements, may actually shorten rather than lengthen professional careers.

This trend highlights the incongruity of these systems with the larger public discussion of pension and Social Security solvency in an era of longer life spans and the impending bulge of retirees. Much of that discussion focuses on raising the retirement age, as part of a solution to the growing funding problems. By contrast, there is little discussion of the incentives to retire early in teaching, despite the growing awareness of funding problems in teacher pensions, along with those of other state and local employees.

A substantial literature in labor economics demonstrates that the incentives in pension systems matter, not only for the timing of retirement, but for labor turnover, and workforce quality (Friedburg and Webb 2005; Asch, Haider, and Zissimopoulos 2005; Ippolito 1997; Stock and Wise 1990). Unfortunately, little of this literature pertains to teacher pensions. While there have been many studies of the effect of current compensation on teacher turnover (e.g., Murnane and Olsen 1990; Stinebrickner 2001; Hanushek, Kain, and Rivkin 2004; Podgursky, Monroe, and Watson 2004), the econometric literature on teacher pensions is very slender. The only published econometric study to date is Ferguson et al. (2006), who find that Pennsylvania teachers' retirement decisions were highly responsive to incentives for early retirement.[2]

In spite of the growing visibility of problems faced by states and districts in the area of pensions and retiree benefits, there is little public understanding of the nature of these programs.[3] Specifically, policymakers and the general public need a better understanding of pension accrual patterns over time, since these provide incentives to retire early or late, and may affect teacher recruitment and retention.

In this paper, we review the general structure of teacher pension plans, and then focus on the key parameters in four states (Arkansas, California, Massachusetts, and Missouri) that determine the accrual patterns for deferred compensation over the course of a typical career. We then discuss the efficiency and equity implications of these patterns, the response to problems that have arisen, and consider fundamental reforms that might address these problems more effectively.

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[1] In addition, there seemed to be an implicit argument that those best suited to public employment have a lower preference for risk, either from job-changing or investment returns in savings-based pension plans.

[2] See also Brown (2006).

[3] Retiree non-pension benefits, especially health, are important issues we do not address in this paper. New state and local government accounting standards, GASB 45, require that these governments report the unfunded liabilities associated with these benefits beginning in 2007. These estimates are not yet widely available.

2. Basic Features of Teacher Pensions

Public school teachers are almost universally covered by traditional defined benefit (DB) pension systems. We say "traditional" because these are the types of plans that were the norm in both the public and private sector until recent decades. However, this is no longer the case in the private sector. In a DB system, the employer has an obligation to provide a regular retirement check to employees upon their retirement. The plans are collective in the sense that employee and employer contributions go into a fund that is supposed to be actuarially sound. In theory, at any point in time there is supposed to be enough money in the fund to pay for all actuarial accrued liabilities, although this is rarely the case. In most states the teacher pension systems have large unfunded liabilities (NASRA 2006).[4]

Typically, a DB teacher pension plan requires that both teachers and employers make a contribution each year. For example, in Maryland, a state in which teachers are part of the Social Security system, during the 2005-06 school year, employees contributed 2 percent and school districts paid 9.35 percent for a combined total of 11.35 percent. This is in addition to the 12.4 percent combined employer and employee contribution to the Social Security system. In Ohio teachers are not part of the Social Security system. They contribute 10 percent and their employers contribute 13.5 percent for a combined total of 23.5 percent.

Teachers become eligible for a full pension based on age and/or service. Different versions of these eligibility rules will be discussed below, but they typically allow one to draw a full pension well before age 65, especially if they have been working since their mid-20s. This is an important difference between teacher pension systems and the Social Security system. In the latter system employees face reduced payments if they retire before age 65.

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

(1) Annual Benefit = (years of service) x (final average salary) x r,

where final average salary is the average of the last few years of salary (typically three) and r is a percentage that we will call the "replacement factor." The product of the replacement factor and years of service is commonly referred to as the "replacement rate." In Missouri, for example, teachers earn 2.5 percent for each year of teaching service.[5] Thus, a teacher with 30 years service would earn 75 percent of the final average salary. So if the final average salary were $60,000 she would receive:

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[4] The unfunded liabilities and funding ratios for the four states included in this study are: AR ($2.2b, 83.4 percent), CA ($20.3b, 85.7 percent), MA ($7.4b, 82.8 percent), MO ($5.2b, 82.6 percent). NASRA Pension Fund Survey.

[5] This formula applies for teachers hired after June 1998. For teachers hired before this date, years of service prior to 6/98 had a lower replacement factor. One can think of the example in the text as a "forward

Annual Benefit = .025 x 30 x $60,000 = $45,000,

payable for life. If the teacher were to separate from service but defer drawing the pension, the amount of the pension would be frozen until that time. Once the pension draw begins, however, there is typically some form of inflation adjustment, although the nature of it varies from state to state.

The traditional DB system described above may be contrasted with a defined contribution (DC) plan. In a DC plan, the employer merely agrees to contribute a fixed amount annually to a retirement account for an employee. For example, a common arrangement in the private sector is for the employer to contribute five percent of an employee's salary and match employee contributions up to an additional five percent. These contributions go into a retirement account associated with that employee. If the employee quits, the fund goes with him. The employer is under no obligation to provide a given payment to the employee at the time of retirement.

Data collected by the U.S. Department of Labor show that DC plans now predominate in the private sector (EBRI 2006). DC plans are particularly attractive for professionals who tend to exhibit high rates of mobility between employers (or who go into self employment and back). Not surprisingly, given their relative high rates of professional mobility, DC plans (predominately TIAA-CREF) tend to be the norm in both public and private higher education institutions. Two states (Ohio and Florida) have introduced limited defined contribution options for new teachers.

Whether or not teachers in a given state or district are covered by Social Security is important in assessing the adequacy of their retirement income systems. State and local employees were originally excluded from the Social Security System when it was set up in 1935. Congress amended the Act in 1950 to permit states to arrange voluntary entry of some or all state and local employees to enroll in the system. Some states and districts choose to do so and some did not (Mitchell et al., 2001). The result is a complicated mosaic. There are fourteen states in which most or all of the public school teachers are not covered by the federal Social Security system, including three of the four states considered below (California, Massachusetts, and Missouri[6]). Obviously, as compared to teachers who are not in the Social Security System, these teachers do not require as large a state or district pension to attain a given level of income upon retirement.

A recent study by Loeb and Miller (2006) provides a very useful catalogue of state policies concerning teacher labor markets. They provide a set of summary tables on pension plan parameters similar to those described above. In addition, they provide summary estimates of the overall replacement rates of these pension systems for states in

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looking" formula, describing the benefit system for new hires. Also, there is currently a temporary provision that raises the replacement factor to 2.55 percent for teachers with over 30 years of service.

[6] However, teachers in the Kansas City and St. Louis school districts are in the Social Security system and have their own separate pension funds. Teachers in the remaining 520 school districts, roughly 90 percent of public school teachers in the state, are in a state pension fund and are not covered by Social Security.

and out of the Social Security system, for teachers with various years of seniority. These estimates take a useful first step in understanding the extent of backloading of these benefits as well as the rate of accrual of benefits. The present paper takes this analysis further, to more fully illuminate the structure of retirement incentives and the return to additional years of work.

3. Pension Wealth and Earnings Wealth

Data on the parameters of teacher pension plans can be used to generate estimates of the magnitude of pension benefits using the concept of present value. When an individual retires under a DB plan, he or she is entitled to a stream of payments that has a lump sum value that can be readily determined, using standard actuarial methods.

By the same token, the stream of earnings over one's worklife can also be converted to a lump sum for the purpose of comparison. It is simply the cumulative earnings over time, with interest accrued. Hence, the two streams of income – earnings during one's worklife and pension benefits during retirement – can be placed on a common footing.

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:

$$(2) \qquad P(a_s) = \sum_{a \geq as} (1+r)^{(a_s - a)} f(a \mid a_s) B(a \mid a_s),$$

where $B(a \mid a_s)$ is the defined benefit one will receive at age a, given that one has separated at age a_s, and $f(a \mid a_s)$ is the conditional probability of survival to that age.

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, since receipt prior to "normal" retirement may entail a penalty, depending on age and years of service. In modeling pension wealth below, we assume that individuals separating at age a_s will choose the stream of payments that maximize present value.

In principle, $P(a_s)$ represents the market value of the annuity. If, instead of providing a promise to pay benefits, the employer were to provide a lump sum of this magnitude upon separation, the employee could buy the same annuity on the market. Conversely, if markets were fully developed, one could sell the rights to one's future pension payments for the same lump sum.

For purposes of comparison, it is useful to define one's earnings wealth analogously:

$$(3) \qquad E(a_s) = \sum_{a < as} (1+r)^{(a_s - 1 - a)} W(a),$$

where W(a) is one's annual wage at age a. Thus $E(a_s)$ is simply cumulative earnings with accrued interest. It can be thought of as the lump sum that would have been sufficient to fund the stream of earnings, as evaluated at the age of separation.

Since pension wealth is the present value of a stream of payments going forward and earnings wealth is the present value of a stream of payments going backwards, both evaluated at the same point in time (at age a_s), they are comparable measures, capitalizing these two components of compensation. The measure of pension wealth that we will present below for the states we examine is $P(a_s)/E(a_s)$, pension wealth as a percentage of earnings wealth.

This measure has a fairly intuitive interpretation, expressing deferred compensation as a percent add-on to compensation during one's working life. Of course, the employee will typically (but not always) be contributing to the pension fund, so the net benefit to the employee is the difference between $P(a_s)/E(a_s)$ and the employee's contribution, as a percent of earnings.

The pension wealth measure $P(a_s)/E(a_s)$ 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 benefit that one will be owed, for any given age of separation.

3.1 Pension Wealth, as Percent of Earnings Wealth for Four States

We calculate pension wealth, as a percent of earnings wealth for the four states of Missouri, Arkansas, California, and Massachusetts. For each state, we make certain common assumptions. We consider a teacher entering the workforce at age 25, and working continuously until leaving service.[7] We assume salaries in each state follow a stylized grid, with parameters based on national data,[8] and we assume all cells grow at 2.5 percent. We assume a 5 percent interest rate, and use a Federal unisex mortality table.[9]

After the individual is vested (five years in Missouri, Arkansas, and California; ten years in Massachusetts), he or she is entitled to a pension of a certain size at a certain age, determined by a formula of the type given in (1). If the individual leaves teaching with sufficient years of service to qualify for the pension, but is too young to receive it just yet, the value of the future stream of benefits is discounted back.

In presenting the following estimates, we would strongly caution the reader against drawing any inferences regarding relative generosity of these pension systems. There are a number of important ways that states differ in their generosity that are not captured in the diagrams below. To begin with the obvious, employee contributions vary. They

[7] Similar diagrams can be drawn for individuals entering service at different ages, above or below 25.
[8] Specifically, we assume teachers move through 20 steps at three percent each, with an additional ten percent for a lane change at six years. The experience step returns and return to an MA were computed from average school survey responses from the 2003-04 School and Staffing Surveys. Our estimate of the number of steps is within the range observed: for teachers with an MA, the maximum step is 22 in New York City, 14 in LA Unified, 23 in San Diego, 21 in Baltimore, and 23 in Miami-Dade. (Source: National Center for Teacher Quality collective bargaining web site. http://www.nctq.org/cb/search.jsp)
[9] The table, for 2003, is drawn from IRS Revenue Ruling 2002-62 Appendix B.

range from 6 percent in Arkansas and California[10] to 11 percent in Massachusetts[11] and 11.5 percent in Missouri. (Note that in many states, individual districts can choose to pay some or all of those contributions for their employees.) There are also important variations in retirement benefits that are not captured in these diagrams. For example, California also provides a mandatory defined contribution plan for all teachers, which includes a 2.5 percent contribution rate by the state. Finally, there are many other features of defined benefit plans that simply cannot be captured in an analysis of this sort, such as the terms and conditions under which teachers can purchase credit years, the ability to artificially elevate the final average salary through various means, and the like. These vary from district to district within a state, as well as between states.

All that said, we believe the diagrams presented here do offer insights regarding the pattern of pension wealth accumulation over one's career. That is, although many of the variations discussed in the previous paragraph may affect the height of the curves shown below, we believe the general shape can be captured by analyses of the type we provide. For reference below, the key features of these programs are summarized in Table 1.

[Insert Table 1 here]

3.1A Missouri

The key features of Missouri's defined benefit plan are a constant replacement factor per year of service (2.5 percent)[12] and eligibility for normal pension at age 60 or earlier, if age + service equals 80, the so-called "rule of 80." Figure 1A depicts pension wealth, as a percent of cumulative earnings, for a 25-year-old entrant to the Missouri teaching force, at various ages of separation. There are three distinct periods of one's career:

(i) Up to age 45, a teacher contemplating separation would have to defer pension to age 60. Each additional year of service will increase the pension benefit to which she will be entitled, accounting for the gentle upward slope of the pension wealth curve.[13]

(ii) At age 46, this teacher would have 21 years of service, which would make her eligible for full pension at age 59, under Missouri's "rule of 80." Each year thereafter, she becomes eligible to receive the pension one year younger. This means she can expect to receive the pension for one year longer, on the front end. The length of expected pension benefits increases each year thereafter until age 53. Consequently, her pension wealth grows much more rapidly over this phase than in the first phase.

[10] This refers to the employee contribution to the defined benefit program proper; employees also contribute two percent to the supplemental defined contribution plan.

[11] This refers to new teachers, since the enactment of the "Retirement Plus" bill in 2000, which enhanced benefits for teachers with service exceeding 30 years.

[12] There is a reduced factor for one early retirement option, but that is dominated by the full retirement options in this paper's simulations. There is also another early retirement option that is scheduled to be discontinued in 2008, so that is not modeled here.

[13] The pension benefit is also one year closer, so it would be discounted one year less, but the passage of a year also raises the present value of past earnings, which is the denominator of our wealth measure.

(iii) By age 53, this teacher is eligible to receive the pension immediately. Each year of further employment merely delays the pension and results in one less year of expected pension benefits. This outweighs the fact that the annual benefit continues to rise with additional service, so pension wealth declines as a percent of cumulative earnings.

Although the specifics of the pattern vary from state to state in significant ways, the general hump-shaped pattern is typical. This illustrates the very uneven nature of pension benefits by age of separation. Those who leave teaching early receive relatively small pension benefits, and those who stay too long also receive less than those who leave in their early-to-mid-50s. Since all employees contribute the same percent of their earnings to the pension fund (11.5 percent in Missouri, for 2005-06), the net benefits are even more unequally distributed than the gross benefits. The question, then, is whether there is any efficiency purpose served by these policies that might justify the apparent inequity. We will return to this below.

[Figure 1A about here]

3.1B Arkansas

The key features of Arkansas' defined benefit plan are similar to those of Missouri. The replacement factor per year of service is constant (2.15 percent[14]). Teachers are eligible to receive their pension at age 60, or earlier, once reaching 25 years of service, but for service levels of 25, 26, and 27 years, the benefit is 85 percent, 90 percent, and 95 percent of normal. Figure 1B depicts pension wealth, as a percent of cumulative earnings, for Arkansas. Again, there are three distinct periods of one's career:

(i) Up to age 49, a teacher who separates would have to defer pension to age 60, much as in Missouri. Pension wealth slopes gently upwards, due to the increase in pension benefit from staying each additional year.

(ii) Upon reaching 25 years of service, at age 50, a teacher would be eligible for pension immediately, albeit at 85 percent of normal rate. This creates a huge jump in pension wealth, by adding 10 years worth of pension benefits, should the teacher separate at that age.

(iii) For ages 51-53, pension wealth continues to rise as a percent of cumulative earnings, even though each year of further employment results in one less year of expected benefits. That is because the penalty for early retirement gets phased out over these two years. By age 53, this teacher is eligible to receive the full pension benefit immediately. From this point on, pension wealth declines as a percent of cumulative earnings.

As in Missouri, pension wealth peaks at age 53. The main difference between the structure of Arkansas' plan and that of Missouri is the more dramatic jump in pension

[14] The pension also includes $900 per year supplement.

wealth in the years just prior to age 53. Instead of a more gradual ramp-up, during which the expected length of pension benefits grows by one year at a time under the "rule of 80," Arkansas' system provides a sudden jump of ten years worth of pension benefits, followed by phase-out of the early retirement penalty. Overall, however, the picture is rather similar.

[Figure 1B about here]

3.1C Massachusetts

There are some key features that distinguish Massachusetts' defined benefit from those we have considered so far. First, teachers are eligible to receive a pension at age 55, or earlier after completing 20 years of service. Second – and considerably more important for the shape of the pension wealth curve – the replacement factor is not constant, but rises with age. This raises the return to additional service credit from an additional year of work, thereby raising the age at which the pension wealth curve peaks.

Specifically, prior to 2001, the formula for the replacement factor was linear in age, rising from 1.0 percent at age 40 to a maximum of 2.5 percent at age 65. This resulted in a very smooth pension wealth curve, as depicted in Figure 1C. The first, red, portion of the curve is similar to the other states, except that these early separators need only defer the pension to age 55 (instead of 60). The second, blue, portion kicks in at 20 years of service, when teachers are eligible for pension at any age, but the pension they receive will be much smaller if the individual chooses to receive it young. Consequently, there is almost no change in the optimal age for deferred pension over this phase (54 vs. 55 on this simulation), and unlike the other states the curve does not get any steeper.

The curve continues to rise gently to age 55 and beyond, when the retiree would draw the pension immediately upon separation. Unlike the case where the replacement factor is constant, pension wealth continues to rise with years of work, even though a year of pension is lost, because that is outweighed by the increase in replacement rate. The curve reaches a smooth peak at age 61, and declines thereafter (due to the ceiling on total replacement of 80 percent). Thus, prior to 2001, the smoothly rising replacement factor meant that pension wealth in Massachusetts grew smoothly and peaked at a significantly later age than the other states we have examined. This formula held both for teachers and for state employees.

In 2000, under heavy lobbying from the state teachers' unions, the Legislature passed "an Act Improving Teacher Recruitment, Retention, and Retirement" – later known as "Retirement-Plus."[15] This raised the replacement factor for teachers with 30 years or more of service, so that they could reach the 80 percent maximum replacement rate at an earlier age. The unions argued that these enhanced pension benefits would "help recruit and retain new teachers by making the profession more attractive." They argued the bill

[15] By way of disclosure, Costrell served in Governor Cellucci's administration at the time and, along with other staff, advised a veto.

would "allow teachers who have been working long to retire with some dignity," and that this would also allow school systems to "pay newer teachers more as the highest paid teachers retire." The main argument against the bill was that it would lead to early retirements at a time of potential teacher shortages. Consequently, the bill included a provision to allow teachers to return to work after two years, which critics dubbed the "double dip" provision.

In addition, there was concern about the fiscal liability, which falls upon the state, not the districts. The bill raised the contribution rate for all new teachers to 11 percent (from 9 percent previously, and as low as 5 percent for those who were hired in the 1970s) in an attempt to make the program actuarially neutral for new hires. Veteran teachers were given the option of buying the new benefit by raising five years worth of contributions to the 11 percent level.[16] Consequently, when the state actuary calculated the net liability due to the new program, in the year after its passage, the estimated addition came to $1.45 billion.

The Governor was joined in his opposition to the bill by the state's main municipal organization, numerous mayors, both of the state's taxpayers' associations, leading business groups, as well as the editorial pages of the state's major newspapers. The Governor's veto, however, was overwhelmingly overridden, by Democrat and Republican legislators alike.

Table 1 gives the enhanced formula for the replacement factor and Figure 1C depicts its effects. After 30 years of service, the replacement rate is raised by 12 percent over what the previous formula provided and 2 percent more for each year thereafter. Thus, for a teacher who entered at age 25, pension wealth jumps at age 55, since the 30th year of service raises the replacement rate from 40.6 percent to 57.0 percent. Pension wealth peaks at age 58, a drop of 3 years from the pre-2001 peak.

[Insert Figure 1C about here]

3.1D California

California's system has some similarities to that of Massachusetts, notably a replacement factor that rises with age, beginning at 1.1 percent for age 50 and rising in linear segments to 1.4 percent for age 55 and 2.0 percent for age 60. Prior to enhancements in 1999 (discussed below), the pension wealth curve rose approximately linearly to a peak at age 60 and declined thereafter, as shown in Figure 1D. Specifically, individuals could start to draw pensions at age 55, but the optimal draw was at 57, for all separation ages below 57. For those who separated at age 57 or beyond, it was optimal to draw one's pension immediately. Each year of working reduced the number of years for drawing a pension, but up until age 60 this was outweighed by the rise in replacement rate.

[16] The state retirees' association defended the program, but criticized the high contribution rate for new teachers, citing "an opinion of many new teachers who feel they have been 'sold out' by being forced into an 11 percent contribution." (…, September 2001)

Beginning in 1999, two changes to the formula came into effect. First, the maximum replacement factor was raised from 2.0 percent at age 60 to 2.4 percent at age 63. Second, upon reaching 30 years of service, the replacement factor at any given age was raised by 0.2 percent (but still capped at 2.4 percent).

The effects on pension wealth are depicted in Figure 1D. For the 25-year-old entrant, there is a jump in pension wealth at age 55, after 30 years of service. In addition, the curve peaks one year later, at age 61, since the replacement factor continues to rise after age 60. Interestingly, the incentives for retirement are arguably mixed. The later peak is an incentive to separate and retire later, but for those who separate at ages 55 and 56, it is optimal to start drawing the pension earlier, at age 56 instead of deferring to 57.

[Insert Figure 1D about here]

3.2 Summary

The main points that emerge from this comparison of pension wealth curves are that states typically have a single-peaked curve, but that there is significant variation due to the specifics of each state's formula, and modifications to those formulas enacted by the Legislature. In addition, a state's pension wealth curve often has distinct segments, with markedly different slopes, which means the annual increments to pension wealth at different ages can vary quite dramatically, as we shall presently show.

4. Annual Change in Pension Wealth, as an Income Measure of Deferred Compensation

Once earnings and pension wealth are defined comparably, as above, it is also useful to consider the corresponding measures of annual labor income, in current and deferred compensation. These measures are derived from the annual growth in earnings and pension wealth. Analytically, it is useful to distinguish between changes in wealth due to a change in the stream of payments (evaluated at the same point in time) and a change in the point in time at which the same stream of payments are capitalized. The latter piece is simply the interest on the previous year's wealth – it is the return to capital, not labor. It is the former piece – the change in wealth due to a change in the stream of payments – that is the proper measure of labor income, either in current or deferred compensation.

Consider first the annual growth in earnings wealth:

$$(4) \qquad \Delta E(a_s) = E(a_s) - E(a_s\text{-}1) = W(a_s\text{-}1) + r\, E(a_s\text{-}1).$$

The first piece, $W(\cdot)$, is simply the annual wage (in the year before separation). It is the change in wealth due to a change in the stream of payments: one more year of employment results in one more wage payment. The second piece, the interest on previous wealth, is simply the result of evaluating the same stream of payments one year

later, and is not of interest here, since it is not a reward for work. Thus, annual earnings income is simply the change in earnings wealth, net of interest:

(5) $e(a_s) \equiv \Delta E(a_s) - r\, E(a_s\text{-}1) = W(a_s\text{-}1)$.

Analogously, the annual income from deferred compensation is the change in pension wealth net of interest on the prior year's pension wealth:

(6) $p(a_s) \equiv \Delta P(a_s) - r\, P(a_s\text{-}1)$.

This can be expressed more explicitly as:

(7) $p(a_s) = \sum_{a \geq as}(1+r)^{(a_s - a)}[f(a \mid a_s)B(a \mid a_s) - f(a \mid a_s\text{-}1)B(a \mid a_s\text{-}1)] - (1+r)\, B(a_s\text{-}1 \mid a_s\text{-}1)$

As stated earlier, this is the effect of deferring separation on the expected stream of pension payments. Let us examine (7) in more detail.

The first term represents the increase in expected pension payments from a_s forward. We see from the bracketed expression, which is positive, that this is due to the rise in benefits from the pension formula ($B(a \mid a_s) > B(a \mid a_s\text{-}1)$), as well as the higher probability of surviving to receive each benefit payment ($f(a \mid a_s) > f(a \mid a_s\text{-}1)$).

Note that if a_s is at an age or service level where the formula allows one to accelerate the first pension draw (e.g. age 46 in Missouri or age 50 in Arkansas, as shown in Figures 1A and 1B), then one or more of the $B(a \mid a_s\text{-}1)$ terms are zero while the corresponding $B(a \mid a_s)$ terms are positive. Thus, at such an age the annual income from deferred compensation includes the sudden addition of one or more years of pension payments, frontloaded. Conversely, if one was already eligible to receive a pension the previous year, at age a_s-1, then deferring separation forgoes that benefit payment, as shown in the last term in (7).

In sum, the income from deferred compensation in any given year has several conceptual pieces: (i) the rise in expected benefit payments due to the formula (more years of service, higher final average salary, and, in some states, a higher replacement factor); (ii) at certain break points in the formula, additional years of pension eligibility; and (iii) later in one's career, the loss of a year of benefits from deferring separation.

4.1 Deferred Income as Percent of Current Income: Patterns in Four States

For each of our four states, we depict the annual income for deferred compensation as a percent of earnings, i.e., $p(a_s)/e(a_s)$. For a teacher entering service at age 25, these curves depict the pattern of deferred vs. current compensation at various potential ages of separation.

It is important to note here that the pension accrual concept used here is different from the actuarial concept. The actuarial concept is based on the assumption that the individual will work to a given "normal" retirement age, independent of the actual age of separation. It is calculated to guide the employer in providing prudent reserves, and it results in smooth curves. The economist's concept, depicted here, is based on the individual's actual year of separation; it is calculated to depict the incentives for individual decisions about separation. As has been previously established in the economics literature, these curves have sharp kinks, leading to strong incentives to stay or leave at various ages.

4.1A Missouri

Figure 2A depicts the annual deferred income, as a percent of current income, for Missouri. Over the first phase of one's career, this component of income is positive, as each additional year of service raises the total replacement rate by 2.5 percentage points, and rises steadily, as the replacement rate is applied to a higher final average salary. By age 45, the annual accrual of deferred pension benefits effectively adds over 40 percent to current income (approximately 30 percent net of the employee contribution, if it is in fact paid by the employee, rather than the district).

At age 46, the "rule of 80" kicks in, as discussed in connection with Figure 1A, reducing the age of first pension draw from 60 to 59. Thus, one more year of work adds the equivalent of one year of pension. Together with the effect of the additional year of service raising the annual pension benefit for the remainder of one's expected retirement, the deferred compensation for the 21st year of service is equivalent to over 80 percent of current income. Over the following six years, the age of pension eligibility continues to drop one year at a time. By age 52, the effect of this additional year of pension – which is worth much more by then, due to higher replacement rate – together with the continuing effect of service on that replacement rate, brings the deferred compensation that year to 178 percent of current income.

The following year, at age 53, there is no further addition to expected pension years, so the deferred compensation is due only to the continuing growth in the annual benefit. Finally, at age 54 and beyond, each year of working requires one to forgo a year of pension benefits, and that loss outweighs the growth of annual benefits.

In short, unless one departs early in one's career, there is a strong incentive – from the viewpoint of deferred compensation -- to stay on the job to age 53, since deferred compensation actually exceeds current income for several years. Beyond the early 50s, however, there is a strong incentive to leave quickly.

[Insert Figure 2A about here]

4.1B Arkansas

Figure 2B depicts annual deferred income, as a percent of current income, for Arkansas. Needless to say, there is a rather striking spike at age 50, when the teacher depicted receives the equivalent of nearly five times her annual salary in deferred income. However, one should not overstate the extent to which this differs from the pattern in Missouri, with which it really has much in common. The main difference is that in Missouri the spike is spread out over several years, due to the workings of the "rule of 80." In both states, the phenomenon depicted is the effect of age and/or service rules accelerating the eligibility for first draw, thereby adding to the number of years one would receive a pension, for separations over this interval.

Again, the general thrust of Arkansas' plan is to encourage early entrants to stay on the job until the early 50s, and to then leave shortly thereafter.

[Insert Figure 2B about here]

4.1C Massachusetts

The annual deferred income for Massachusetts teachers is depicted in Figure 2C. The deferred return to work is relatively high, throughout the early phases of one's career – reaching 50 percent by the early 50s – due to the fact that the replacement factor is not constant, but rises with age. Prior to 2001, the deferred return to work hovered around that level through the 50s and then gently declined, going negative at age 63.

The "Retirement-Plus" enhancements in 2001 created a large spike at 30 years of service, such that a 25-year-old entrant would earn three times as much in deferred income at age 55 as in current income. As discussed above, this was due to the fact that teachers add 12 percentage points to the replacement rate at 30 years, over and above the previous formula. The deferred return continues to be high through age 58, due to the new formula, and then goes negative at age 59, as the 80 percent cap is reached earlier than under the old formula.

In sum, prior to 2001, the Massachusetts pension system had much less distortion of the incentive to stay or leave than some other states. The deferred return to employment was relatively smooth, with no particularly strong incentive to stay or leave until age 63. Since 2001, however, the inducement to stay into the mid-50s became quite dramatic, and the incentive to leave got pushed forward about four years.

[Insert Figure 2C about here]

4.1D California

The story in California is similar to Massachusetts, since both states have replacement factors that rise with age, but there are some important differences. Figure 2D depicts the annual deferred income in California. Both before and after the changes in 1999, annual deferred income rises to almost 50 percent of current income by the mid-50s. There is a spike at 25 years of service (age 50 for the 25-year-old entrant), at which point California

takes final average salary to be the highest single year (rather than the average of three years), a provision which is unique in the nation. Aside from that peak, the pre-1999 pattern had no other upward spikes. Deferred income went sharply negative after age 60, since that was the point at which the replacement factor reached its maximum.

The changes in 1999 created the spike depicted in Figure 2D, at 30 years of service, or age 55 for the 25-year-old entrant, since the formula adds six extra percentage points to the replacement rate at that point. This would seem to provide a large incentive for teachers to stay on the job until that point, although if they choose to separate then, it is actually optimal to accelerate by a year the pension draw, as discussed above. Beyond that point, the annual deferred income is approximately the same as pre-1999, but continues to hover around 50 percent for an extra year and does not go negative until after age 62. This makes California unusual, in adopting pension changes that provide some incentive to separate later, rather than earlier.

[Insert Figure 2D about here]

5. Historic Rationales, Equity & Efficiency

Historically, the rationale for public defined benefit plans was to encourage longevity. As the NEA Research Division has pointed out, however, this purpose has "been lost for many in the mists of time," and "many pension administrators would be hard-pressed to give an account of why their systems are structured as is except to say that 'the Legislature did it' or 'It is a result of bargaining.'"[17]

As we have seen, many pension systems no longer encourage longevity. Indeed, the same NEA report cited above also reported on survey results that found the most common changes in retirement plans, recent or planned, were for early retirement provisions, and we have analyzed an example of this in Massachusetts.

To the extent this has occurred, is there any reason to believe that this has efficiently advanced public policy? That is, has the socially optimal retirement age dropped? We are not aware of any evidence that it has.

To be sure, the rhetoric put forth by advocates of pension changes has cited teacher burnout (presumably more pronounced now than in previous times) and the need to get fresh blood in the classroom. But even taken at face value, this is an argument for portability, not early retirement. The other argument put forth has been the need to enhance recruitment, but, again, there is no reason to believe that early retirement provisions are more attractive to new hires than current compensation (either across-the-board, or differentiated). Indeed, to the extent that augmented retirement provisions are partially funded by higher employee contributions, this can easily make recruitment more difficult.

[17] NEA 1995, p. 3.

From a societal viewpoint, there would seem to be a prima facie case that with expanded life spans, and the impending demographic bulge, the retirement age should be raised, not reduced. That, of course, is much of the thrust around Social Security debates. For state and local pensions, surely the disjunction between longer life spans and lower retirement ages is a significant underlying contributor to the funding crises we observe.

Equally as important, however, as the question of the overall retirement age, is the importance of individual variation. Perhaps in the distant past all teachers were drawn from the same profile, with the same career paths. Today, however, it is more widely recognized that we have a fluid workforce, and a far greater variety of individual needs and talents that can be brought to the teaching force. Some will be individuals who will teach for a few years, while young and energetic, and then move on to something else. Others will be individuals whose wisdom grows with age and whose students will benefit greatly from such beloved elders. Still others will have acquired valuable experience in other fields (e.g., engineers) and seek to give back to society with a mid-career change. The breadth of individual variation raises important efficiency and equity concerns about traditional defined benefit plans that were designed for a different era.

On equity grounds, we have seen in Figures 1A-D that the gross pension benefit received, as a percent of cumulative earnings, varies widely depending on whether one separates early, late, or at the curve's peak. Netting out the employee's contribution (which is typically a constant percentage) means the benefit is even more uneven. Unless there are powerful efficiency reasons to drive employees to some pre-specified retirement age, these inequities would seem to be indefensible.

On efficiency grounds, there can be no rationale for driving all teachers to the same separation age, and this is now widely recognized. One might think this would lead to serious consideration of fundamental reform, such as transitioning to cash balance plans (discussed below). Unfortunately, the response instead has been to continue adding enhancements to the same defined benefit structure, with the additional feature of allowing more teachers to take early retirement and then return to teaching, possibly after a short hiatus.

6. Post-Retirement Re-Employment

We have seen that teacher pension systems often have strong incentives built into them to encourage teachers to retire at relatively young ages, at least as compared to Social Security and private sector plans. Clearly, many teachers, even if they nominally "retire" at age 55 or 57, will continue with labor market work of some sort for many years. Given concerns about "teacher shortages" and pressures from the No Child Left Behind Act to make sure that all classrooms are staffed with qualified teachers, it makes little sense for districts to nudge qualified, and presumably effective, teachers out the door at such early ages. Not surprisingly, all teacher pension systems have loopholes to allow educators to continue to teach and collect their pension (sometimes called "double dipping"). Our impression is that the loopholes are expanding. Let us briefly consider some of them.

1. Part-time employment. All four of the pension systems considered here allow teachers who have retired to continue to work in covered employment on a part-time basis (without accruing additional benefits). Missouri and Massachusetts set limits on hours (550 per year and 960, respectively). California and Arkansas set limits on earnings ($27,060 in California, and two times the Federal Social security earnings limit in Arkansas). States can raise these bars and seem to be doing so.

2. Employment in shortage areas. Missouri allows teachers to work up to three years full-time in a "critical shortage" area. The district must document existence of a critical shortage. In Massachusetts, once a "critical shortage" is declared and approved, retirees can return to teaching without restriction, unless they have retired under the "Retirement-Plus" enhancements; in that case, they must wait two years before returning to service. Similar waivers exist in the other states. These waivers seem to be expanding.

3. Break in employment. California allows teachers who retire and leave CalSTRS employment for 12 months to return to full time teaching with no loss in pension benefits.

4. DROP plans. Many states have implemented Deferred Retirement Option Plans (DROP's). These permit teachers to continue working full time for a specified period of time (one to five years), during which all or most of their pension check goes into what amounts to an individual retirement account. When the teacher stops working, the IRA can be collected as a lump sum or paid out over time. Arkansas has such a plan. National surveys suggest that interest in such plans is increasing (Bragg, 2003).

5. Changing pension systems. Teachers can cross a state line or a district boundary and work in a different pension system. For example, Missouri teachers in the state pension system can retire and work full-time in the St. Louis or Kansas City systems. Or they can cross the border and work in Kansas. In these cases there is no limit on post-retirement earnings.

The result of all of these loopholes is that the decision to "retire" (i.e., collect a retirement check) is not necessarily the same as a decision to quit teaching in public schools. Unfortunately, we are aware of no national data on this topic. Standard sources of national survey data about teachers such as the School and Staffing Surveys (SASS) assume in their survey design that working teachers are not retired and retired teachers are not working. Hence by construction they cannot detect the phenomenon. One study using state administrative data (Podgursky and Ehlert 2007) followed mid-career Missouri teachers in the pension system described in this study from the 1990-91 to 2006-07 school year. Of the roughly 21,000 teachers who retired over this interval, 14 percent taught at least one year subsequent to retirement. They also tracked one recent cohort of retirees and found that roughly ten percent taught in the year subsequent to retirement, with half of those being full time. The share of retired educators teaching dropped to six percent by six years after retirement (42 percent full time). This study only considered reemployment in Missouri public schools and did not count retired Missouri educators teaching in another state.

In short, the relaxation of re-employment restrictions, together with some limited evidence on re-employment, indicates that the DB incentives to retire young have created a problem to which these measures are a response. Rather than addressing the problem at its source – a system with undesired incentives – these measures seem designed to convert DB early retirement incentives into another form of current compensation, albeit a rather Byzantine one, not accessible (or even comprehensible) to all.

7. Cash Balance Plans

Cash balance (CB) plans offer an alternative to traditional defined benefit formulas which are essentially neutral in the incentive they offer for the timing of separation. In the private sector, many large corporations have switched from traditional plans to CB plans over the last twenty years, and some public entities – including some teacher pension systems – have started to include some CB or CB-type components in their plans. CB plans are very similar to DC plans, but have some significant differences.

As in DC plans, employees and employers contribute a certain percentage of earnings to a retirement account. The first difference is that the account is notional rather than actual: there is not a specific fund in the individual employee's name, but rather an individual claim to a bookkeeping entry, which may or may not be fully backed with existing funds at any given moment.

The more important difference is that the return to the account is defined by the plan, rather than market returns to the specific assets in which the funds are invested. The defined return is typically set at a rate comparable to risk-free bonds. By comparison with DC plans, this is as if the employee were barred from investing funds in risky assets.

CB plans are legally considered (for tax and regulatory purposes) to be another variety of defined benefit, since the plan defines the rate of return. Another implication is that the employer is required to establish a trust to fund the obligations, and issues of unfunded liabilities can arise here, as under traditional DB plans. However, these issues are typically considered to be more manageable, since the liabilities are known with greater certainty, although the same risks exist on the asset side (by design): market returns can deviate from the defined return.

When the individual separates or retires, the notional account is payable to the individual, either as a lump sum, or convertible to an annuity, or some combination of the two. There are restrictions on these choices that can vary from plan to plan.

The neutrality of CB plans with regard to age of separation can be simply depicted. In the pension wealth diagrams (1A-D), the curves would simply be replaced with flat lines, at a percentage given by the sum of employee and employer contributions. That is, pension wealth, as a percent of cumulative earnings, is constant, independent of age of

separation.[18] This eliminates the inequity in pension wealth between those who separate at different ages.

The neutrality of CB plans' incentive effects can be seen most readily from the annual deferred income: those diagrams (2A-D) are also flat, at the same percentage. That is, each year, the individual is credited with deferred income equal to the percent contributed by the employer (as well as the employee's contribution, which is essentially forced savings). This neither rises nor falls over one's career, in contrast to the DB profiles, with their spikes and negative returns.

On this last point, consider the difference between CB and traditional DB late in one's career. Under traditional DB plans, deferred income turns negative because one forgoes a year's worth of pension payments, and this outweighs any growth in the annual benefit. Under a CB plan, this does not happen: annual deferred income continues to be the same percentage of earnings, which is added to pension wealth. Converting this wealth to an annuity – for comparison with traditional DB – the annual payment is correspondingly larger due to the decision to wait a year before conversion. That is, the fact that there is one year less remaining in one's expected life span simply means that one can buy a larger annual annuity payment with the same lump sum (over and above the increase in the lump sum from the additional year's contributions and defined return). Conversely, traditional DB formulas punish individuals for staying on the job beyond a certain point by failing to raise the annuity payment by an actuarially fair amount.

In short, CB plans are incentive-neutral with respect to retirement, quite unlike the traditional DB formulas. This leaves the employee much more latitude to arrive at individually optimal separation decisions, based on his or her lifestyle preferences. It also makes it much easier for the schools to tailor their workforce to the educational needs of the students. In our view, this is preferable by far to the heavy-handed DB formulas, supplemented by makeshift DROP formulas or other re-employment provisions.

8. Conclusions

Policy discussions about teacher recruitment, retention, and quality often focus on young teachers; however, the timing of retirements also has important consequences for the teaching workforce. In addition, pension policy has powerful effects on K-12 school finance. Teachers who retire in their mid-fifties not only create vacancies that must be filled, they also draw pension benefits for periods of time that are likely to equal or exceed their years of service employment. A teacher retiring at age 55 with a $50,000 annual pension (indexed) has received an annuity valued at over $1 million. Nor does this take into account her retiree health insurance benefits. Indeed, because the pension systems create incentives for teachers to retire long before they are eligible for Medicare, a costly demand for retiree health insurance arises as well.

[18] To be sure, this assumes that the same rate of return is applied to the CB account as pertains to cumulative earnings, but that is certainly a reasonable approximation.

In this paper we have examined in some detail the rather complicated patterns of pension wealth accrual and work incentives built into four state pension systems. All four systems exhibit highly non-linear rates of accrual of benefits, with sharp spikes in the growth of pension wealth from additional years of work at certain points in a teacher's career, and negative returns shortly thereafter. These features create powerful incentives to retire relatively young, as early as the mid-to-early 50's in some states.

Outside of teaching, given growing life expectancy and the looming retirement of the baby boom generation, the focus of policy discussions has been to reform Social Security and Medicare so as to raise retirement ages, and postpone retirement. It is increasingly obvious that these teacher pension systems run counter to that trend. Indeed, some reforms, such as deferred retirement options (DROP's), are explicitly meant to address the widening gap between teacher pension eligibility and Social Security. Yet adding these types of "reforms" make already complex systems nearly unfathomable.

As scholars new to this area, we are struck by the extraordinary complexity of these teacher pension systems. This stands in sharp contrast to trends in other sectors, where defined contribution or cash balance schemes are relatively simple and transparent. We believe that the type of analysis proposed in the paper, which makes the redistributive and incentive effects of these teacher pension systems clearer, is an important step in discussions of teacher compensation reform. As education policymakers consider ways to attract and retain a new generation of teachers, teacher pension systems deserve serious scrutiny.

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Table 1: Key Features of State Defined Benefit Plans				
	Arkansas	California	Massachusetts	Missouri
Eligible to Draw Pension* (after vesting: 10 yrs in MA; 5 yrs in AR, CA, MO)	Age = 60; or Service = 25, benefit reduced 5% x (28-S)	Age = 55; or 50 if Service = 30	Age = 55; or Service = 20	Age = 60; or Service = 30; or Age + Service = 80
Replacement factor (percent per year of service)	2.15% + $900	Linear segments: 1.1% at age 50 1.4% at age 55 2.0% at age 60 2.4% at age 63 For S $\geq$ 30, add 0.2% to factor, to max of 2.4%	Linear: 0.1% at age 41 to 2.5% at age 65 For S $\geq$ 30, add 2% x (S-24) Max replacement = 80%	2.5%
COLA formula	3%, simple	2%, simple, plus floor of 80% initial purchasing power	CPI to max of 3%, simple, on first $12,000	CPI, compound, up to 1.80 maximum factor
* excludes options for early retirement that are dominated by other choices in this paper's simulations				

Figure 1A. Pension Wealth vs. Age of Separation: Missouri
age of first pension draw indicated

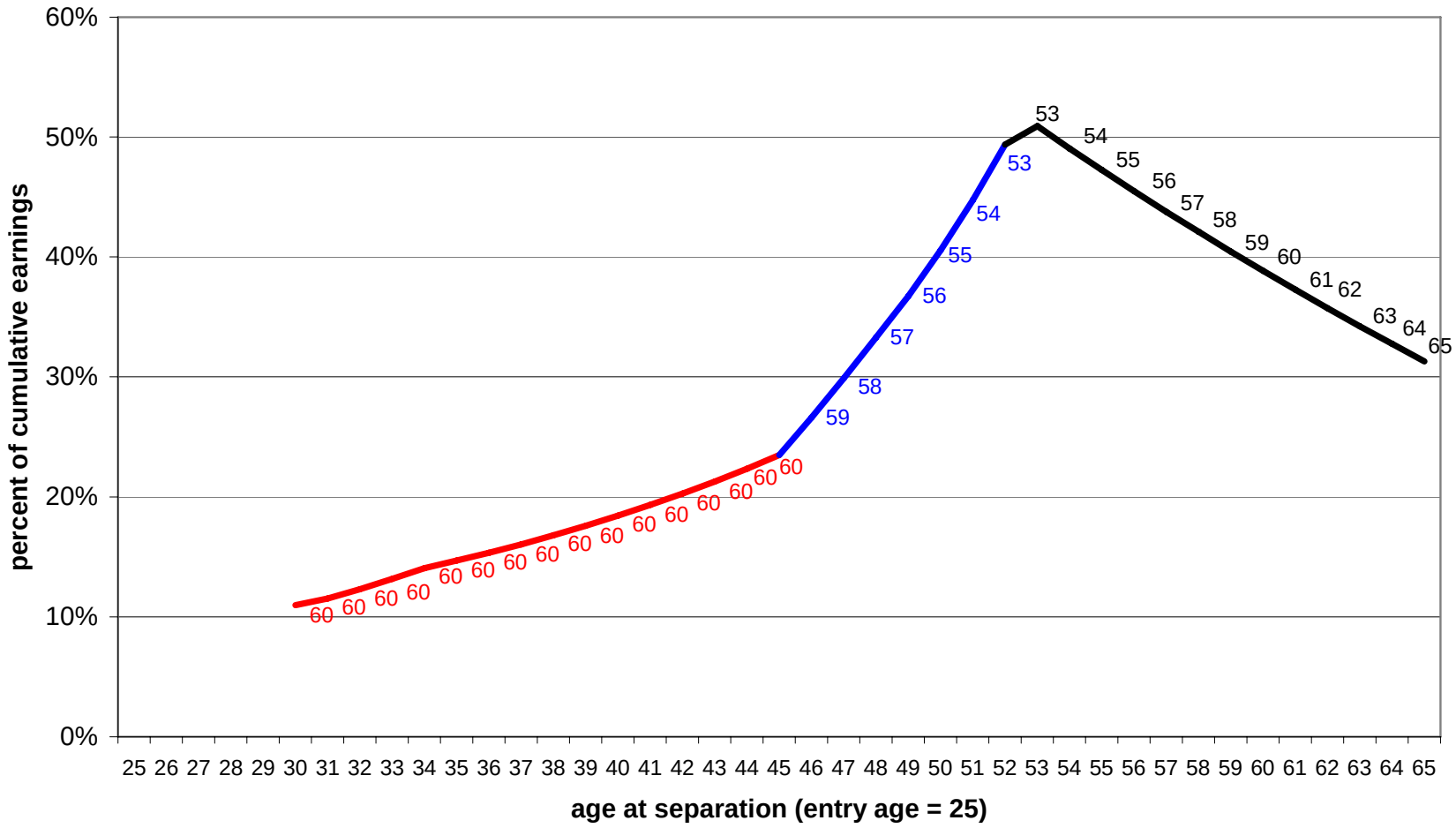


Figure 1B. Pension wealth vs. Age of Separation: Arkansas
age of first pension draw indicated

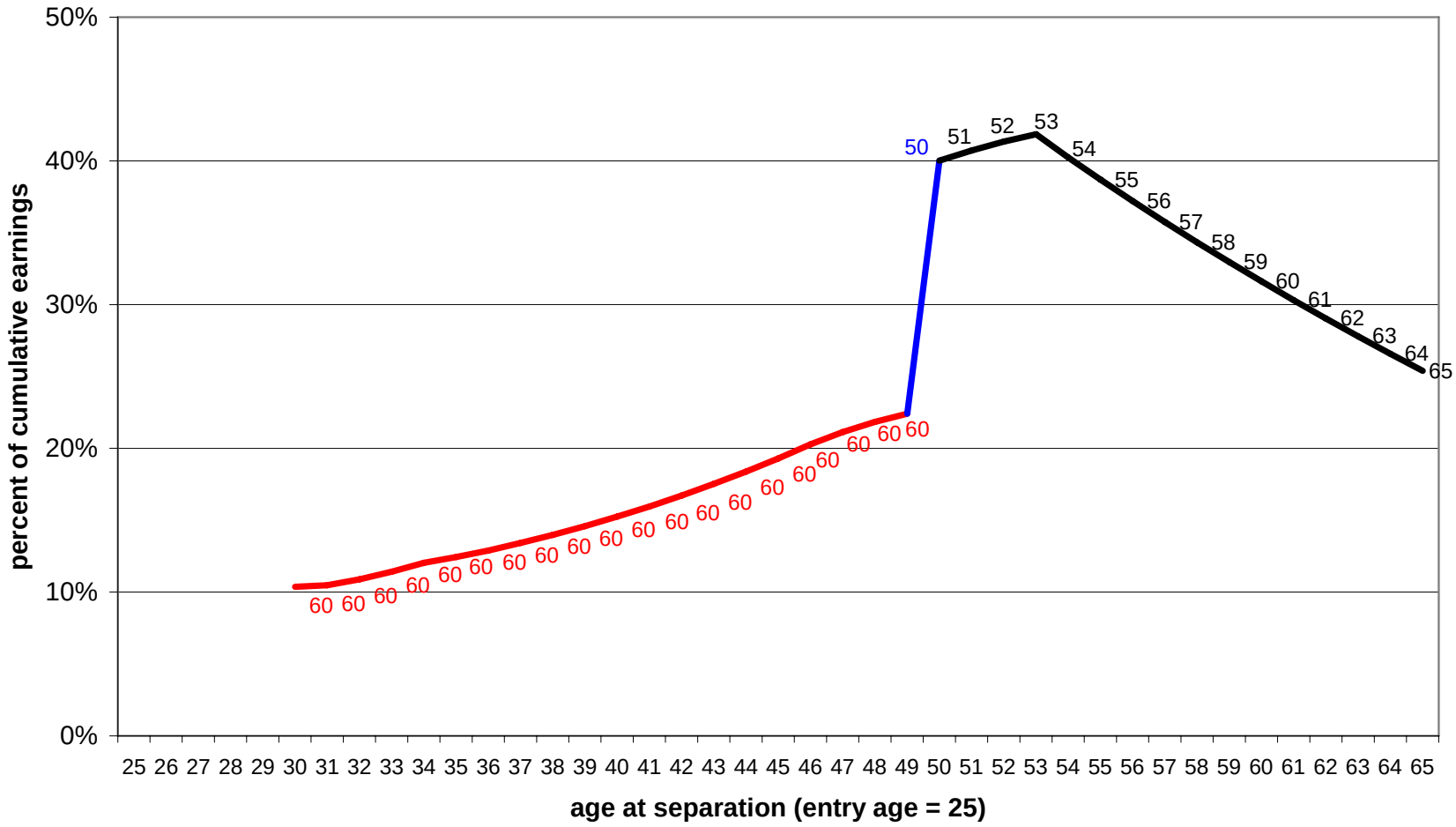


Figure 1C. Pension Wealth vs. Age of Separation: Massachusetts
age of first pension draw indicated

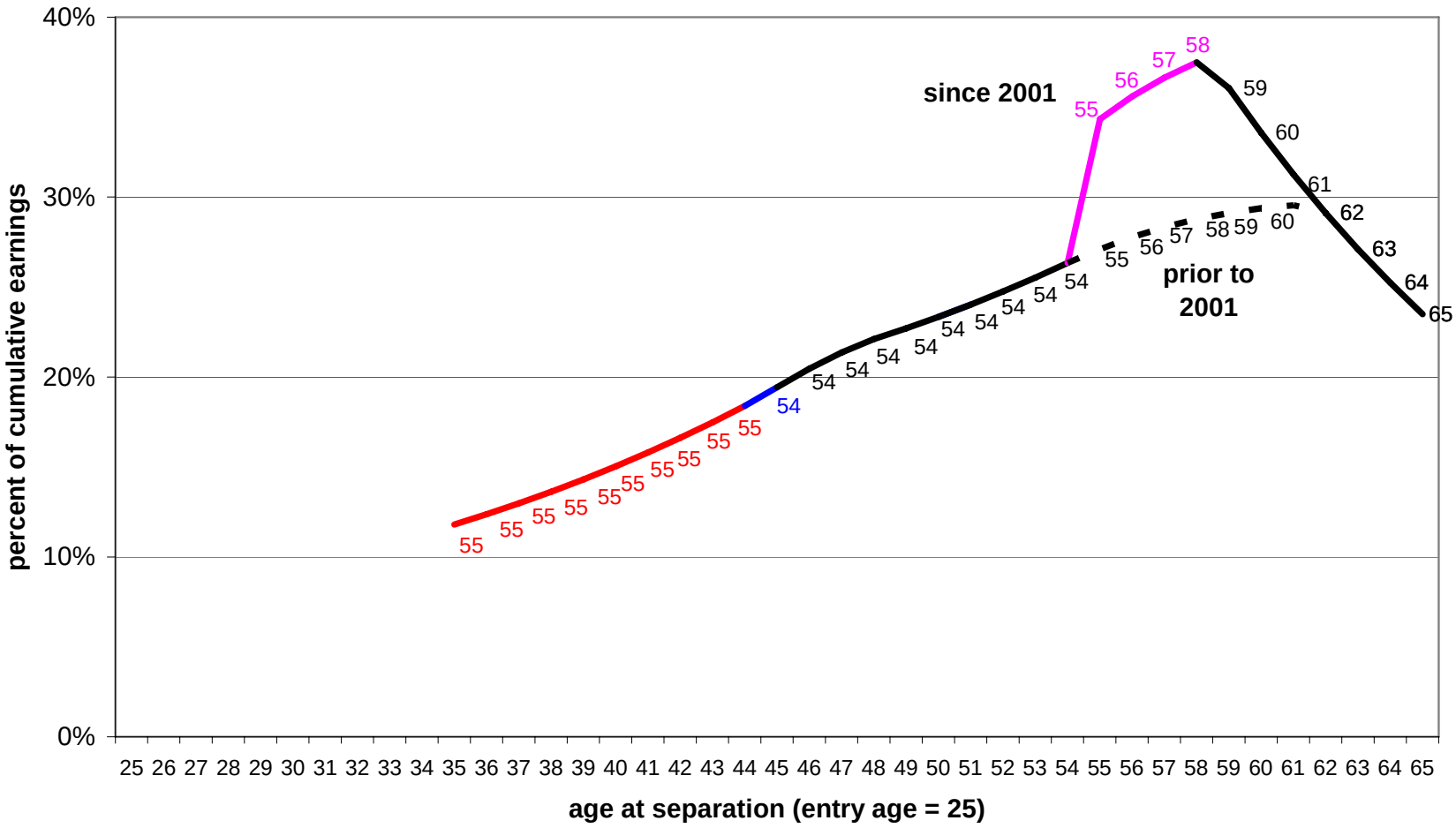


Figure 1D. Pension Wealth vs. Age of Separation: California
age of first pension draw indicated

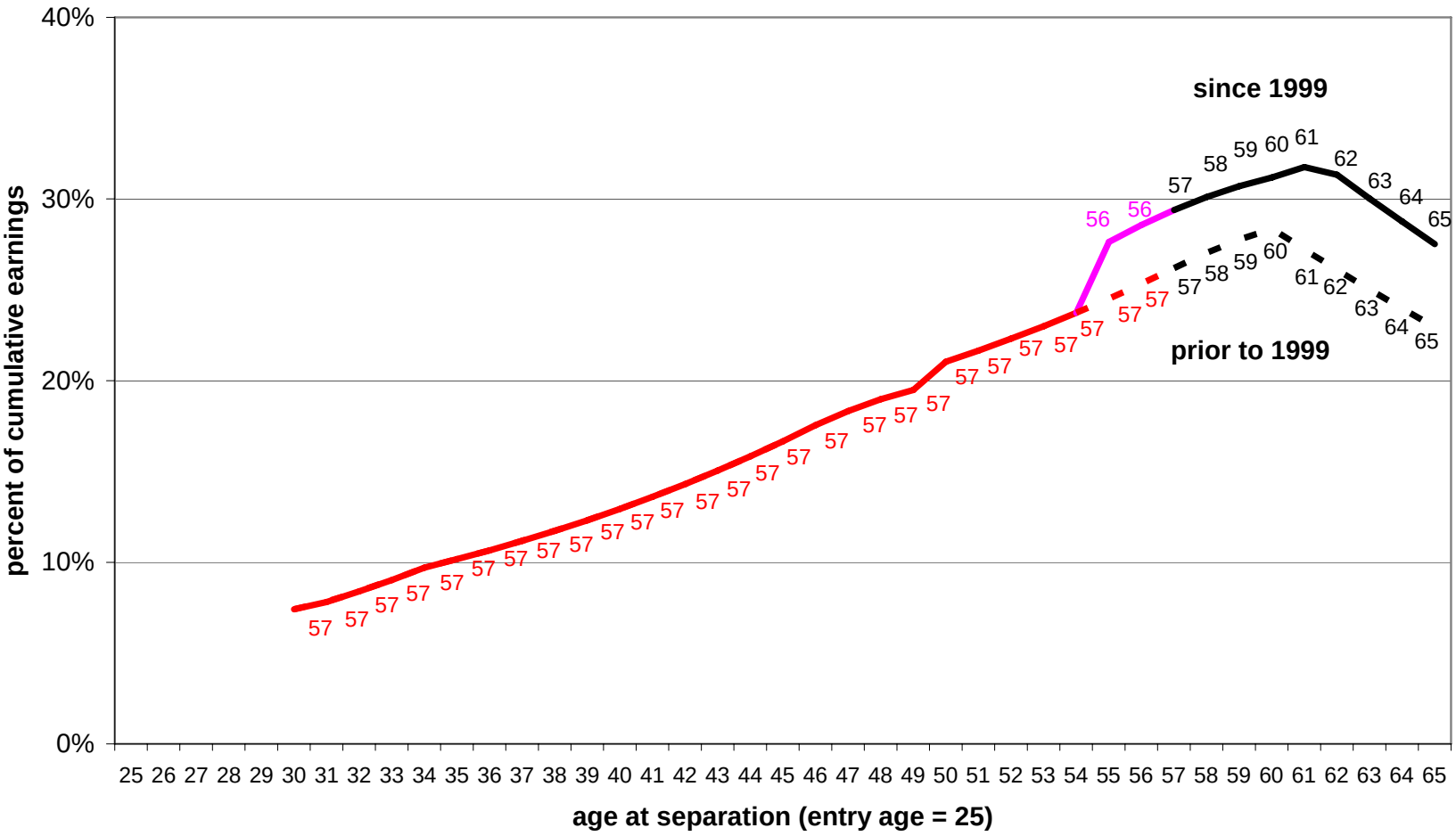


Figure 2A. Annual deferred income: Missouri
age of first pension draw indicated

Figure 2B. Annual deferred income: Arkansas
age of first pension draw indicated

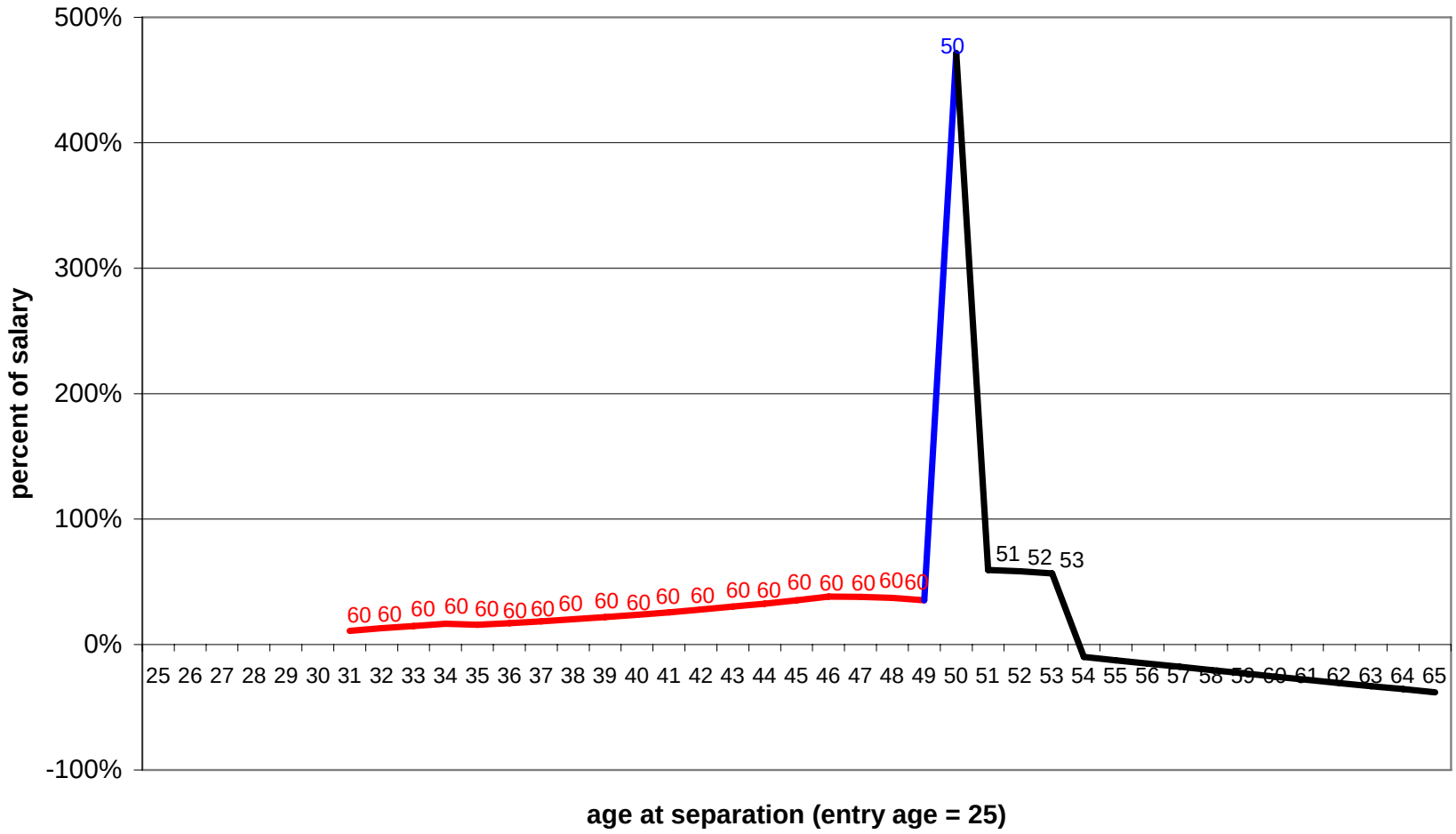
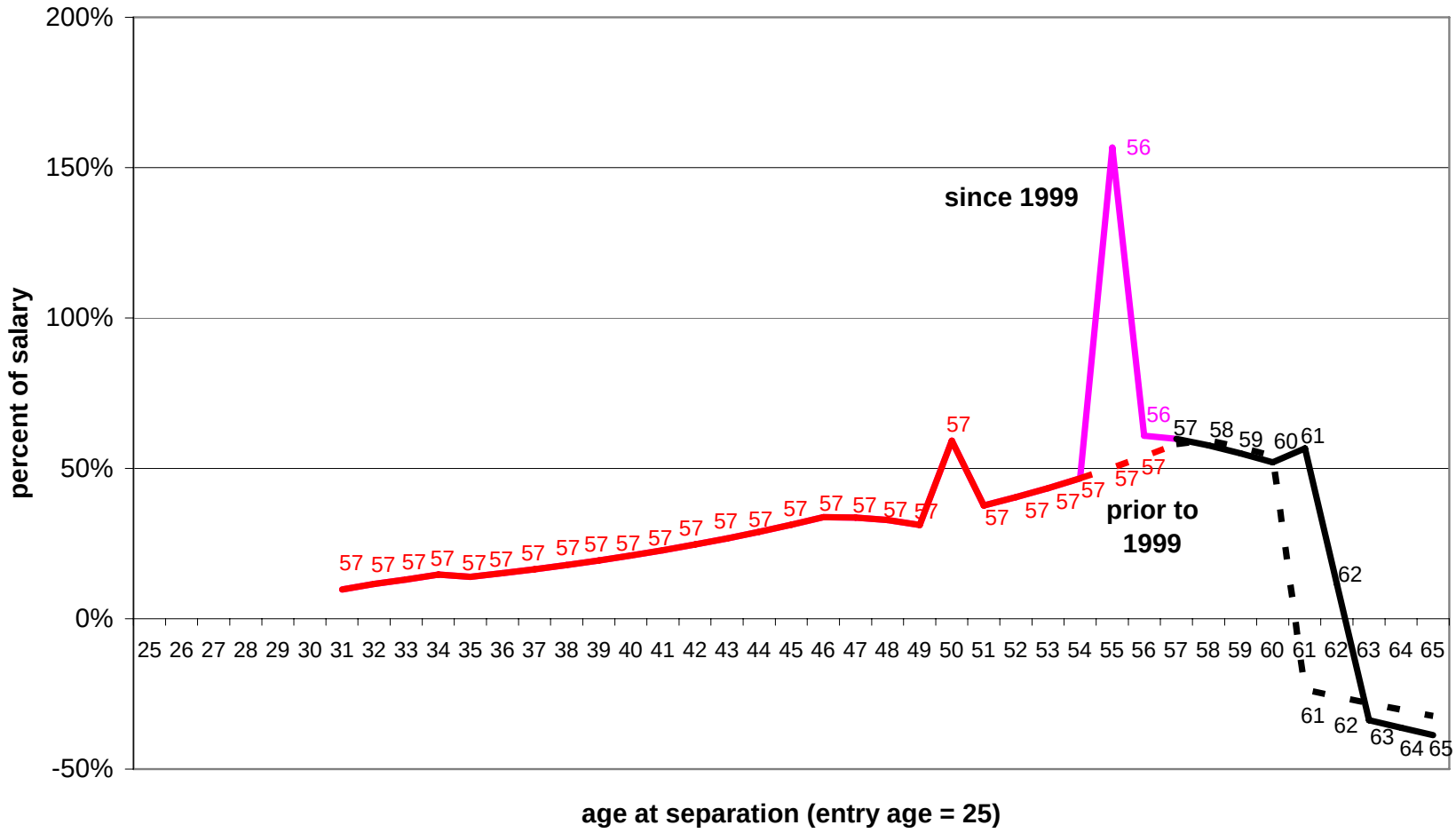


Figure 2C. Annual deferred income: Massachusetts
age of first pension draw indicated

Figure 2D. Annual deferred income: California
age of first pension draw indicated




CALDER