Are California Teachers Better off with a Pension or a 401(k)?

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EXECUTIVE SUMMARY

> Overall, the CalSTRS pension benefit structure—which is designed to reward teachers who stay until at least early retirement age—is better matched to the needs of the active teaching workforce than 401(k) or cash balance plans.

Pensions form a significant part of public school teacher compensation, and provide the primary source of retirement security for teachers, many of whom are not included in Social Security. While most private sector employers have shifted the retirement benefit costs and risks to employees by switching to 401(k) style plans, most public school teachers are still covered by defined benefit pensions that provide guaranteed retirement income and reward long service. While 401(k) plans have the advantage of portability for a mobile workforce, defined benefit pensions provide greater retirement income security and reduce turnover. Given the role of retirement benefits in meeting both employer goals for workforce retention and employee goals for retirement income security, this study examines the suitability of defined benefit pensions for California teachers compared to alternative retirement benefits.

Recent studies have questioned the adequacy and fairness of defined benefit pensions—including the pension provided by the California State Teachers' Retirement System (CalSTRS)—based on the fact that a large percentage of new-hire teachers drop out early, and thus do not stay long enough to collect full pension benefits.* These studies conclude that an account-based system would be fairer, whether that be a defined contribution plan such as a 401(k) or a cash balance plan. However, while early career turnover is a serious concern with respect to lost investment in training, analyses based primarily on new-hire attrition rates ignore the fact that most classroom teaching positions are not occupied by those who leave after a few years, but by those who stay long term.

This study compares CalSTRS pension benefits for California public school teachers to alternative retirement benefits, focusing on the currently active teaching workforce. We first analyze teacher turnover patterns and project the final tenure—years of service at retirement or separation—for the current teaching workforce using CalSTRS' actuarial assumptions. We then model benefits under alternative plan designs—an idealized 401(k) plan and a generous cash balance plan that guarantees 7% interest on contributions—and compare them to the current CalSTRS pension for teachers hired since 2013. Finally, we analyze benefit outcomes for the three plans in the context of our tenure analysis findings in order to estimate the share of active teachers who are better off in the current defined benefit plan versus alternative retirement plans, and vice versa.

Overall, the CalSTRS pension benefit structure—which is designed to reward teachers who stay until at least early retirement age—is better matched to the needs of the active teaching workforce than 401(k) or cash balance plans. Although early career turnover is high, most of the teachers that a student will have during their K–12 education journey in California will have served 20 to 30 years or more before they leave public education in the state. Thus, the vast majority of the educators currently

* Johnson and Southgate 2015; McGee and Winters 2013.

serving in California public schools can expect to collect pension benefits under CalSTRS that are superior in value and security to what they could receive under an ideal 401(k)-style plan. The CalSTRS pension system also offers significantly higher benefits compared to a generously modeled cash balance plan for a large majority of active teachers. **Ultimately, switching to an account-based retirement system—such as a 401(k) or cash balance plan—would sharply reduce the retirement income security of teachers who account for a large majority of educational labor in California.**

KEY FINDINGS ARE AS FOLLOWS:

1. **Most classroom teaching in California is performed by long-career teachers who are well-positioned to benefit from a traditional pension.**
    - The typical teacher in the classroom today can expect to leave at age 61, and half of teachers (49%) will retire with 30 or more years of service.
    - Three-quarters of classroom teaching is performed by teachers who will have been covered by CalSTRS for at least 20 years by the time they depart.
    - The typical new hire in California schools is significantly older than the 25-year-old illustrated in recent studies. The current median age for new hires is 29, and the mean is 33.

2. **For the vast majority of California teachers (six out of seven), the CalSTRS defined benefit pension provides greater, more secure retirement income compared to a 401(k)-style plan.**
    - The CalSTRS defined benefit pension becomes more valuable than an idealized 401(k) at age 51 for vested teachers hired before age 35, and earlier for those hired at older ages. The vast majority of active teachers (86%) in the state will stay in California schools until at least age 51.
    - Our model assumes that everyone receives the reduced benefit formula implemented for new hires since 2012—2% of final average salary replaced at age 62. This is a conservative assumption because in reality, most current teachers fall under the older, more generous pension formula—2% at age 60.
    - In addition, four out of five active teachers (79%) will stay until at least age 56, when the CalSTRS pension exceeds the value of a generously structured cash balance plan.

3. **Conversely, only one out of seven teachers currently teaching in California schools will accrue less benefit under the CalSTRS defined benefit plan than they would if contributions were deposited into a defined contribution, 401(k)-type plan—assuming average investment returns.**
    - Only 14% of active teachers will receive less benefit from the CalSTRS defined benefit plan than a hypothetical defined contribution plan. This includes 6% comprised by recent hires who will leave before vesting, i.e., with less than five years of service, and 8% comprised by teachers who will vest, but leave before age 51, when the defined benefit benefit starts to exceed the defined contribution benefit for younger hires.
    - Another 7% will vest, but leave between ages 52 and 56, when the defined benefit pension becomes more valuable than a hypothetical cash balance plan with generous benefits. Thus only one out of five active teachers (21%) would accrue higher benefits under a generous cash balance plan compared to the CalSTRS pension.
    - The biggest reason why the CalSTRS pension provides a lower benefit than the idealized defined contribution plan for the 8% of teachers who vest but leave before age 51 is that the final salary used to calculate benefits loses value over time if the separation date occurs before retirement age. Indexing the final average salary to inflation during this period would mitigate this loss, but require a slightly higher contribution rate.

4. **Focusing on new-hire attrition rates is misleading.**
    - While 40% of new hires leave before vesting, these leavers represent just 6% of teaching positions. The vast majority of public school teaching in California is performed by educators who have remained, or will remain, beyond the initial high-attrition years and are very likely to stay long term.

- While some active teachers who terminate prior to retirement eligibility may receive higher benefits under an idealized account-based retirement plan, this advantage is dwarfed by the larger benefits that the vast majority of active teachers will receive under the DB plan compared to alternative plans.
- From a public education policy perspective, it makes little sense to restructure retirement benefits to advantage those who leave, in a manner that dramatically reduces benefits for those who conduct the vast majority of teaching work.

5. **401(k) and cash balance plans generate their own risks and inequalities in retirement income, decreasing the incentive for early and mid-career teachers to stay, and making it harder for older teachers to retire.**
   - Account-based retirement plans reward those who leave early with proportionally greater retirement benefit than those who stay. For instance, contributions for a 25-year-old yields lifetime retirement income worth more than 3% of that year's pay in inflation-adjusted terms, compared to less than 1% for someone on the cusp of retirement.
   - 401(k) plans create stark, arbitrary inequalities between retirement cohorts because retirement income varies wildly with financial market conditions. Roughly half of teachers will either have income that exceeds the expected benefit by one-third or more, or have income that falls short by one-third or more.
   - Given the lack of deferred compensation in defined contribution and cash balance plans, and the lower benefits compared to defined benefit pension for those who stay until retirement age, account-based retirement benefits would increase the incentive for early and mid-career teachers to leave, and also decrease the ability of older teachers to retire.

I. INTRODUCTION

> The CalSTRS pension benefit structure, which is designed to reward full-career teachers, is generally well-matched to the career trajectories of most California teachers.

For retirement income security, California public school teachers rely primarily on the California State Teachers' Retirement System (CalSTRS), which covers nearly 880,000 members and beneficiaries, including nearly 421,000 active members.[1] The primary retirement benefit—as in most public school systems—is a traditional defined benefit (DB) plan in which lifetime monthly benefits are calculated based on age, number of years of service, and final pay. This benefit is funded jointly by teachers, school districts, and the state. Because California teachers are not covered by Social Security, the CalSTRS pension represents their sole source of guaranteed retirement income.

Some recent studies—including one focused on CalSTRS—have been critical of teacher DB pensions, arguing that "most teachers" do not receive meaningful pension benefits.[2] Such studies cite turnover and job mobility as the basis for claiming that account-based retirement plans—i.e., a defined contribution (DC) plan such as a 401(k) or a cash balance (CB) plan—would deliver greater, more equitable benefits to teachers.[3] CalSTRS offers portability of benefits throughout the entire state. But more importantly, analyses based exclusively on cohort turnover give equal weight to those who leave after a single year of service and those who will have spent decades teaching under the same pension system by the time they retire. This approach offers little insight into whether the pension system fits the career trajectories of the educators who are actually working in classrooms and schools across California at any given time.

The purpose of this study is to evaluate the suitability and adequacy of the CalSTRS pension system for California teachers in comparison to alternative retirement plans, through an analysis of:

1. Overarching policy considerations in evaluating retirement benefit design for public school teachers;
2. The tenure profile—projected length of service at withdrawal or retirement—among teachers currently serving in California public schools; and
3. Projected retirement benefit outcomes under an idealized 401(k) plan and a generous cash balance plan, compared to the current DB plan.

We find that the CalSTRS pension benefit structure, which is designed to reward full-career teachers, is generally well-matched to the career trajectories of most California teachers. The typical classroom teacher today can expect to separate at age 61 with 29 years of service. In addition, the vast majority of teachers (86%) will stay until age 51 or later, when even teachers hired at younger ages can expect to collect retirement benefits that are superior, in terms of both benefit value and income security, to what they would receive under an idealized 401(k)-style plan—assuming 1) low fees; 2) no investment mistakes; and 3) average market returns. The CalSTRS pension system also offers higher benefits compared to a generously modeled cash balance plan for most teachers.

This study demonstrates that the teachers who leave during the initial high-turnover years account for a small share of overall teaching workload—and by extension, a small share of students taught. This is because those who survive the crucible of on-the-job learning and new job adjustment tend to stay in California schools for the long haul—a fact that has serious implications for any proposal to restructure retirement benefits, and for any action to correct imbalances in the benefits provided to partial- and full-career teachers.

While there is indeed inequity between short- and long-career teachers in a traditional DB pension, this is mitigated by two factors. First, the vast majority of teaching is performed by long-career, as opposed to short-career, teachers. Second, a DB plan generates higher retirement income than does a 401(k) plan, partly through plan efficiencies and partly through the fact that the employer bears substantial risk on behalf of employees. When individuals bear these risks, costs increase. For instance, DB pensions pool longevity risk, and offer annuities at significantly higher interest rates—and therefore lower cost—than insurance companies. Finally, the shortfall in benefits for younger, shorter-career teachers compared to what they could earn in a DC plan can be mitigated within a traditional DB platform by indexing final pay to inflation, though this will entail an incremental increase in plan cost.

Another consideration is that account-based retirement plans do not erase inequality in benefits—at least, not from a retirement income perspective. Instead, 401(k) and CB plans create another form of inequality that makes little sense from a workforce management perspective. They provide young, inexperienced teachers proportionately higher retirement income—as a percentage of real pay—compared to older, more experienced teachers. In addition, 401(k) plans generate large, arbitrary windfalls and deficits in retirement income for teachers with the exact same career trajectory, but different start and retirement dates because of financial market fluctuations.

THIS REPORT IS ORGANIZED AS FOLLOWS:

- The remainder of this section highlights the analytical distinction between turnover and tenure, and provides a summary of California teacher retirement benefits.
- Section II discusses three key policy considerations for teacher retirement plan design—retirement income security, workforce management, and efficiency—and considers these factors in the context of research on teacher turnover, tenure, and mobility.
- Section III analyzes tenure, hire age, and exit age among active California teachers.
- Section IV presents the results of benefit modeling for alternative retirement plans, compared to the current CalSTRS DB pension, and applies our tenure analysis findings to the results to estimate the share of currently active teachers who are better off in the DB plan, or better off in the alternative plans.

UNDERSTANDING TENURE, AND WHY TURNOVER DOES NOT TELL THE WHOLE STORY

Recent critiques of DB pensions for teachers have hinged on turnover statistics. New teacher attrition is about 30% in the first five years from the profession as a whole, and higher at the level of schools and pension systems.[4] Thus an argument that "most teachers" do not earn reasonable benefits from traditional DB pensions, which favor long careers, may seem compelling at first glance. However, as labor researchers recognize, turnover rates say little about actual career patterns in an industry or profession. A detailed analysis of tenure—the projected length of time that each worker will stay, based on how long they have already worked—is required to understand whether "most teachers" are short-term or long-term. In other words, is most teaching in California performed by short-timers who stand to gain little from a back-loaded pension plan, or career teachers who are better off with a traditional pension than a 401(k) plan?

In order to understand this, let us take two employers—Employer A and Employer B—that have 100 jobs each. Both have 100% turnover, meaning that there were 100 separations/new hires over the course of the year. However, this translates into very different workforce profiles depending on the timing and location of turnover.

For Employer A, every position turns over once a year and all of the firm's positions are filled by short-term workers. In contrast, Employer B finds that new workers rarely stay more than a few weeks, but that those who survive the first year tend to stay for the long-haul. In this case, 10 positions turn over 10 times each year, and the other 90 positions have been stable for several years.

These different tenure profiles—one in which most positions turn over frequently, and one in which only a few positions do—have different implications for retirement benefit design. A traditional pension makes more sense for a firm that relies on long-term employees than for a firm that relies mostly on short-term workers. At the same time, retirement benefit design itself has an impact on turnover and tenure.

OVERVIEW OF CALIFORNIA TEACHER RETIREMENT BENEFITS

The CalSTRS DB pension provides the primary, and generally the only, source of secure retirement income for California public school teachers. Teacher retirement benefits in California have three components: a traditional DB pension, a supplemental Cash Balance plan, and a voluntary DC system. Unlike private sector employees and some public employees, California public school teachers are not covered by Social Security.

CalSTRS Defined Benefit Pension

The primary component is a DB plan administered by CalSTRS and jointly funded by teachers, school districts, and the state. In this study, the term "CalSTRS pension" refers to this DB plan. Benefits are based on the number of years of service multiplied by an age factor, multiplied by either a 12-month or three-year final average salary. There are two main benefit formulas, depending on hire date. Teachers hired before 2013 are covered under the 2% at 60 formula, which provides an initial benefit of 2% of final salary per year of service at age 60. That is, a teacher with 29 years of service retiring at age 60 will receive 58% (2% x 29) of the average of their highest 12 consecutive months of pay. (If the retiree chooses a joint survivor annuity that will provide income to a spouse after the teacher passes away, the benefit is reduced somewhat.) The multiplier, or age factor, is reduced for early retirements with a minimum retirement age of 55. The age factor is increased for later retirements and reaches a maximum of 2.4% per year of service at age 63.[5]

In 2013, the California Legislature enacted pension benefit reductions for new hires through the Public Employee Pension Reform Act (PEPRA). Teachers hired in 2013 and later are covered under a 2% at age 62 formula; that is, they need to work to age 62, rather than age 60, to reach a 2% multiplier for benefit calculations. Accordingly, the multiplier for retirement years before age 62 is reduced in comparison to the pre-PEPRA benefit and tops out at 2.4% at age 65.[6]

The "normal cost" for the CalSTRS DB pension system—defined as the percentage of payroll required to fund promised benefits for each year's service—is 14.42% for separations and retirements under PEPRA for new members.[7] A small additional amount is added to the pension cost to cover death and disability benefits.

Funding for the pension comes from employees (teachers) and employers (school districts and the state). Employer contributions to CalSTRS are dependent on state legislation, in contrast to the California Public Employees' Retirement System (CalPERS), which has the authority to adjust employer contribution rates in response to financial market conditions. Because the rates set by the state legislature for teacher pensions have consistently fallen short of actuarially required levels for decades, CalSTRS was 68.5% funded as of Fiscal Year (FY) 2014.[8] Fortunately, in 2014 the state enacted a funding plan to close the system's projected $73.7 billion funding gap and restore the plan's funding level to 100% over 32 years.[9]

Historically, California teachers have contributed 8% of pay towards the normal cost of their pension. Under PEPRA, new teachers are required to pay for at least half of the normal cost of the plan. In addition, the state's plan to restore CalSTRS to full funding includes teacher contribution increases. Rates were raised incrementally from 8% in FY 2014 to 9.205% in FY 2017 for the 2% at 62 benefit, and to 10.25% for the 2% at 60 benefit.[10]

Cash Balance Plan (Defined Benefit Supplement Program)

The second component is a CB Plan called the Defined Benefit Supplement (DBS). When teachers perform "extra-pay duties" outside their normal work, for instance teaching a summer class or coaching a sports team after school, and thus accumulate more than one year's worth of service, the pension contributions for the excess service are deposited in DBS.[11] The fund is invested by CalSTRS in much the same manner as the main pension fund, and maintains a notional account for each teacher that includes contributions, a minimum annual interest credit based on the 30-year Treasury rate, and extra earnings depending on the fund's investment performance. Balances can be cashed out as a lump sum upon separation or retirement, or converted into an annuity on favorable terms compared to private insurance interest rates.

Voluntary Defined Contribution Plan

The third, voluntary component is a DC system in which employees manage their own contributions and investments. The most common plan types are 403(b) plans and 457(b) plans, which are essentially 401(k)-style plans for governmental, education, and nonprofit employees. California has a highly decentralized system in which more than 1,000 individual school districts select private plan providers and investments, and there is little control over fees and fund quality.[12] Teachers can also opt for Pension2, the 403(b)/457(b) plan managed directly by CalSTRS.

No Social Security Coverage

Historically, the retirement system in the US has three pillars: Social Security for basic income, employer-sponsored pensions, and personal savings. However, public agencies are not required to participate in Social Security, and must opt in to do so. Many governmental employers, under the logic that they can provide retirement income more economically through an employer-sponsored pension system than through Social Security, have not opted in. CalSTRS members voted against opting into Social Security in 1955.[13] While nationally, public pensions for non-Social Security workers tend to be modestly more generous than plans for those covered by Social Security,[14] that is not the case for California teachers. CalSTRS pension benefits for teachers are not any more generous than the typical CalPERS plan for state and local government workers with Social Security. A key advantage of most public pensions, including CalSTRS, is that the age for claiming full retirement benefits is higher—60 for older members and 62 for new members under CalSTRS compared to 66, going on 67, for Social Security.

Teachers who have more than 40 quarters of Social Security taxable earnings—e.g., from previous jobs—see their Social Security benefits reduced by the Windfall Elimination Provision. Similarly, the Government Pension Offset reduces spousal and widow/widower's benefits under Social Security. A teacher who would otherwise have $1,000 in monthly Social Security widower benefits and receives as little as $1,500 from CalSTRS will have their entire spousal benefit eliminated.[15]

COMPARING THE DATA IN THIS REPORT WITH OFFICIAL CALSTRS-PUBLISHED STATISTICS

Most of the data in this report is based solely on the 421,000 active members in the CalSTRS defined benefit pension plan, and is meant to represent California's current educational workforce. In effect, our data is weighted by teaching position, which in turn serves as a proxy for teaching workload. In contrast, official published statistics from CalSTRS reflect its total member population, consisting of active, inactive and retired members—including many who left California schools a long time ago—and weighs each individual equally regardless of the amount of teaching work performed.

Our results look forward to the future behavior of the active membership, in order to estimate the share of teaching positions—and teaching workload—filled by educators who are better off with the current CalSTRS pension versus an idealized 401(k)-type plan, and vice versa. CalSTRS-published statistics look back at the prior behavior of its total population over time. This means our results will not directly align with CalSTRS-published statistics on historical teacher career and retirement patterns.

For example, the average (mean) retirement age currently reported by CalSTRS is 62, with 25 years of service.[16] This is the average age at which members initiated retirement benefits from CalSTRS, regardless of when they worked or separated from service. In contrast, this report projects a mean exit age of 60 and a median exit age of 61 for active members, with a median 29 years of service. The median exit age is based not only on retirement, but also on other ways a member could leave CalSTRS-covered employment, including separation from service and—to a much smaller extent—disability and death before retirement eligibility. (Members who become disabled while eligible for immediate retirement will collect pension benefits like any other retiree. And if a member dies while eligible for retirement, their surviving spouse collects their share of CalSTRS pension benefits.)

The member segment we use—active versus the total CalSTRS population—and timeframe of analysis explain the differences between the data in this report and official CalSTRS-published statistics.

II. POLICY CONSIDERATIONS FOR TEACHER RETIREMENT PLAN DESIGN

Workplace retirement plans serve a dual purpose, in that they serve employee goals with regard to retirement security, and employer goals with respect to workforce management, e.g., recruitment, retention, and productivity. These goals must be balanced against efficiency and risk.

From the employer perspective, the choice between defined benefit (DB) pensions and alternative plans is contingent on preferences for long-career versus short-career employees, willingness to absorb risk, and cost. From the employee perspective, retirement security in terms of both the level and predictability of income is the likely primary factor, and empirical evidence on teacher choice seems to support the conclusion that teachers—including new hires—prefer DB pensions.

Ultimately, if the goal of teacher retirement plan design is retirement income security and long-term teacher retention, DB pensions are preferable. If public school employers want to shorten average tenure and are willing to absorb the cost of increased turnover—and teachers are less risk-averse than their current behavior indicates—then they might prefer defined contribution (DC) plans such as 401(k)s or cash balance (CB) plans.

RETIREMENT INCOME SECURITY: INCOME AND OLD AGE INSURANCE VS. WEALTH

Pensions, like Social Security, were created as old-age insurance to ensure that seniors can retire with a decent standard of living after a lifetime of work. Pensions and Social Security also socialize key risks related to retirement income security, including the risk of accumulating insufficient assets and longevity risk (the risk of outliving one's savings). In the case of Social Security, these risks are borne by society as a whole. In the case of workplace DB pensions, they are pooled across the workforce and ultimately borne by the employer.

Analyses of retirement benefits that are framed entirely in terms of wealth, or account balances, neglect the critical value of DB pensions as insurance. Because employers serve as the guarantor, participants enjoy income security that is impossible to purchase in the private market without considerable cost. To achieve the same level of retirement income security on their own, workers would have to invest exclusively in low-risk securities such as Treasuries or high-grade bonds, and compensate for lower returns with a much higher contribution rate. They would also have to engage in sophisticated investment strategies to ensure that their portfolio generated a predictable income level regardless of the interest rate environment.

Private sector workers now face heightened retirement income insecurity. Since the 1980s, increasing financial market volatility, improved life expectancy, declining employer commitment to employees, and regulatory changes that have increased the cost of DB pensions have led to the decline of corporate DB pensions and the rise of 401(k) plans.[17] In the world of 401(k)s and IRAs, the focus is on retirement wealth—account balances—rather than on retirement income.[18] As an increasing share of older workers and retirees rely on DC plans as the key source of retirement benefit after Social Security, participants are challenged to turn their account balances into a consistent income stream.[19]

While policy debates continue regarding the capacity of employers and governments to absorb the risks in DB plans, there is a strong body of evidence indicating that the shift to DC plans in general, and the focus on retirement wealth rather than retirement income in particular, have been harmful to workers' retirement security.[20] Academics, policymakers and the financial sector are focused on retirement income solutions, such as encouraging participants to think about monthly or annual retirement income and income replacement, rather than lump-sum retirement wealth, and structuring DC plans to encourage conversion of account balances to lifetime income.[21]

WORKFORCE MANAGEMENT

In general, schools have an interest in reducing turnover and encouraging older teachers to retire. Turnover is high in the early years of teaching. Recent studies estimate that 30% of new teachers leave the profession within the first five years—not as high as originally thought, but still substantial.[22] Turnover is costly, both in terms of lost investment in training and the transaction cost of hiring new employees. One study estimated the annual cost of turnover in the early 2000s in San Francisco and Oakland school districts to be about $12 million a year each.[23] At the same time, older teachers may be less productive, or at least more expensive, once they reach a certain age. DB pensions allow employers to encourage older workers to leave, without running afoul of anti-discrimination laws. As we will discuss further in this paper, the CalSTRS DB pension evidently succeeds both in retaining teachers for the long haul, and in encouraging teachers to exit in their 60s.

DC and CB plans, in contrast, would increase the incentive for young and mid-career teachers to leave, and also decrease the ability of older teachers to retire. Furthermore, a 2011 study released by the Center for American Progress suggests that because turnover is negatively correlated with teacher effectiveness, increased turnover resulting from a DC or CB plan will lower the average effectiveness of the teaching workforce.[24]

EFFICIENCY AND RISK

A shared goal of employees and employers is to generate the greatest benefit for the lowest cost. This is contingent in large part on the willingness of the employer to bear risk, without which the cost would be much higher.

Based on the ability to pool risk across individuals and over time, with the employer serving as guarantor, DB pensions feature key efficiencies that make it possible to offer significantly higher income compared to a DC plan, assuming equal funding. These include:

1. A long time horizon that allows the plan to maintain a higher level of exposure to risky investments compared to individuals, who need to de-risk as they age.[25]
2. Longevity risk pooling and employer guarantees that allow the plan to offer annuities at significantly higher interest rates than insurance companies.
3. Professional management of asset allocation and investments, avoiding many of the investment mistakes common among individual investors.

Based on a longer investment horizon and employer-backed longevity risk pooling , DB pensions provide benefits at a lower cost compared to an idealized DC plan. Based on these two factors plus professional investment management, DB pensions have an even greater cost advantage compared to an individually-directed DC plan.[26] That is, DB pensions are able to generate higher retirement compared to DC plans for a given contribution rate.

These fundamentals have been validated in studies that rely on rigorous, apples-to-apples benefit model comparisons.[27] While there have been several studies contesting the finding that DB plans are more efficient, none have included a rigorous comparison of outcomes based on equal cost.[28]

DISTRIBUTIONAL ISSUES

Back-loaded benefits in traditional DB pensions are widely recognized, but in retirement income terms, DC plans are markedly front-loaded (**Table 1**). A plan that appears to treat older and younger employees equally in one sense—e.g., the same percentage of pay is contributed by the employer—may treat them in a radically different manner, when the value of the benefit is calculated in terms of retirement income. That is, each dollar contributed to a 401(k) or credited to a CB plan on behalf of a 60-year-old employee will yield significantly less income than the same amount contributed on behalf of a 30-year-old employee, assuming that the contributions are invested in the same investment portfolio. This is particularly true in CB plans, because the employer continues to carry risk on behalf of employees after they separate from service.

DB pensions offer the best opportunity to give employees roughly equivalent retirement income benefits, as a percentage of pay, no matter when they enter or leave the system. This can be accomplished with either a final average salary formula in which final pay is indexed to inflation until normal retirement age, or a lifetime average salary formula in which each year's pay is indexed to inflation.

Ultimately, distributional issues need to be considered side by side with efficiency and benefit adequacy.

Table 1

Illustration of Front-loaded Benefits in 401(k) and Cash Balance Plans

	Year 1 **(Age 30)**	Year 31 **(Age 60)**
Salary (A)	$40,000	$100,000
10% Contribution	$4,000	$10,000
Real value of contribution at age 65, after investment earnings and inflation (B)	$14,891	$11,870
% of Salary (B/A)	37%	12%

Note: *Assumes 7% compound annual investment return. Values are inflation adjusted.*

EMPIRICAL EVIDENCE ON TEACHER PREFERENCES

Few states have offered teachers a choice between DB and alternative retirement benefits. Washington and Ohio are the only two states in the US that currently offer teachers a choice between a DB plan and a hybrid plan consisting of both a DB and DC component funded by mandatory contributions. In addition, West Virginia offered the choice to switch from a DC plan to a DB plan more than a decade ago. The evidence favors the view that teachers prefer the secure retirement income provided by DB pensions over the potential upside in a DC plan. In addition, there is evidence that in DC plans, teachers—like all workers—are vulnerable to financial market conditions that can negatively affect their retirement income security.

In the Washington case, the state offered substantial financial incentives for existing teachers to switch to the hybrid and made the hybrid plan the default choice for new hires.[29] In addition, the DC component allows teachers to annuitize their DC account balances at rates that are higher than what they would normally receive from an insurance company.[30] Three-quarters of existing teachers agreed to switch to the hybrid when it was first introduced in 2007, and there is some indication that the introduction of the hybrid plan in the context of bull market conditions leading up to 2007 may have influenced teacher choice. However, in light of the subsequent financial crisis and recession, preferences among new hires seem to have tipped back towards the DB pension. The share of new hires actively choosing the DB plan increased from 39% in 2007 to 55% in 2013.[31]

Ohio introduced choice between a DB plan, DC plan, or a DB/DC hybrid in 2001, establishing the traditional DB plan as the default. Ohio provided no financial incentives to switch to a particular plan, but the DB plan comes with retiree health benefits while the DC plan does not. Between 2002 and 2014, about three-quarters of teachers stayed with the DB default, 13% elected the DB plan, 9% elected the DC plan, and 4% elected the hybrid.[32]

In 1991, West Virginia closed its Teacher Retirement System, a DB pension plan, to new teachers. It established a DC plan as the primary retirement benefit for new teachers and allowed existing members to switch into it. By 2003, the state recognized that older teachers who had switched into the DC plan had inadequate resources to retire after the financial bubble burst in 2001. Despite a combined employer/employee contribution rate of 12%, only 6% of teachers over age 60 had balances greater than $100,000. West Virginia started bringing new hires into the DB plan, partly to increase teacher retirement income security and partly to restore funding levels in the Teacher Retirement System, which had plummeted after closure. Offered the choice, 79% of existing teachers in the DC plan chose to switch to the DB plan, including 75% of teachers under 45.[33]

In choosing DB plans over DC plans, are teachers being irrational? A more plausible explanation is that risk aversion probably plays a strong role in teacher choice. Teachers likely place a high value on the guaranteed retirement income provided by traditional pensions, compared to 401(k)-style accounts in which they must bear investment risk. Put another way, teachers appear to discount 401(k) benefits more steeply than they do traditional pension benefits, given the differences in risk between the two plans. Thus, even though a new teacher knows she might fare better with a 401(k) under average market conditions, she also knows that there is a significant possibility of loss, and a nontrivial chance of catastrophic loss, given recent historical experience.

In the next section, we demonstrate that in both financial value and income security terms, the CalSTRS DB pension offers the best value to California teachers.

III. TURNOVER AND TENURE AMONG CALIFORNIA TEACHERS

> We find that the vast majority of classroom teaching in California is performed by teachers who are well positioned to benefit from a traditional pension because they work a full career, or work mid-to-late-career in the state.

In order to understand the implications of pension design for California educators, it is critical to determine the extent to which teaching is performed by those who start early in their career and leave too soon to fully benefit from the CalSTRS pension, versus those who stay at least until early retirement age when the pension's back-loaded benefit structure begins to work to their advantage. As we illustrated in the introduction, two hypothetical employers with identical turnover can have very different tenure profiles among current workers. Where turnover is high in the early months or years of employment, but relatively low in subsequent years, the majority of positions are filled by workers who stay for the long haul. Furthermore, where a retirement system covers multiple employers—such as CalSTRS does across California school districts—system-level retention rates are much higher than would be indicated by school- or district-level turnover.

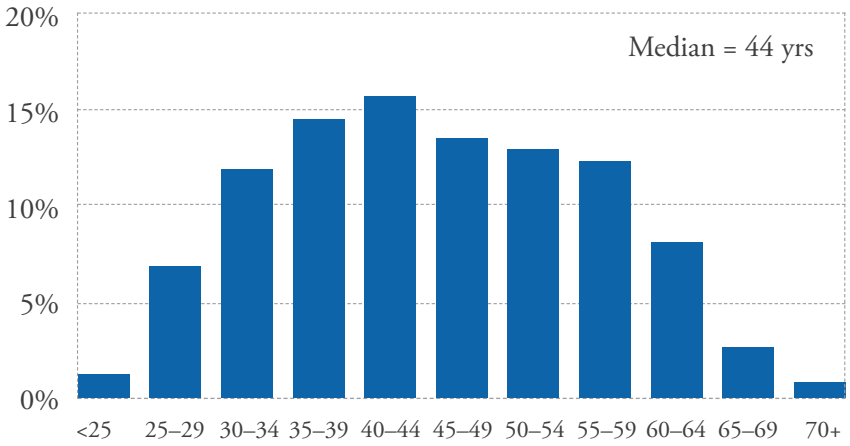
In this section, we analyze the age and accrued service profile of the state's teaching workforce, and then apply CalSTRS actuarial assumptions regarding age- and service-specific turnover rates to project the age at which each teacher will leave, and the number of years of service they will have accrued by then. We find that the vast majority of classroom teaching in California is performed by teachers who are well-positioned to benefit from a traditional pension because they work a full career, or work mid-to-late-career in the state.

1. The current median age for new hires is 29, and the mean is 33. Half of new teachers fall between ages 25 and 37. Thus most new hires in California schools are significantly older than the 25-year-old illustrated in recent studies to emphasize the disadvantages of final average salary defined benefit (DB) pensions.
2. The median projected exit age for active CalSTRS members is 61. The vast majority of California teachers (84%) will separate from service when they are at least 55 years old, having vested.
3. Half of active teachers (49%) will retire with a full career's worth of pension credits under their belt, 30 or more years of service.[34] Another quarter (26%) will have been covered by CalSTRS for at least 20 years by the time they separate or retire. In total, three-quarters (75%) of active teachers will serve at least 20 years.

In other words, most California teachers are on track to have a full career, or end their careers in California public schools. As we will see in the next section on benefit modeling results, this has significant bearing on how most teachers fare in the CalSTRS pension plan compared to rigorously modeled outcomes for alternative retirement plans.

Figure 1

Age Distribution of California Teachers

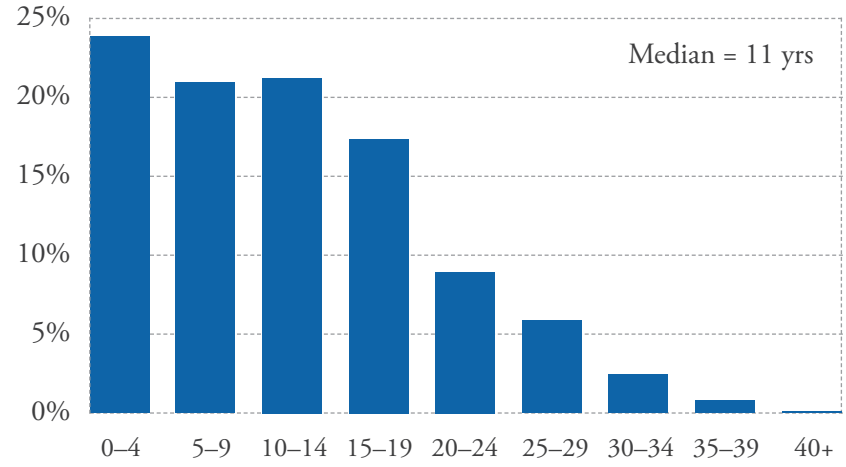


Note: *Authors' analysis of CalSTRS active membership data as of June 30, 2014.*

The California teaching workforce is distributed relatively evenly across the age spectrum, with a median age of 44 years (**Figure 1**). This pattern is roughly in line with the state's college-educated labor force.[35] It also reflects overall population aging; during the 1970s, the teaching workforce was more heavily skewed toward younger ages.[36]

Figure 2

Accrued Service among California Teachers



Note: *Authors' analysis of CalSTRS active membership data as of June 30, 2014.*

Half of active teachers have 11 full years of service or less in California schools (**Figure 2**). Given the even age distribution revealed above, this indicates that a significant share of teachers in this state started their career relatively young, or are older teachers who arrived mid- or late-career.

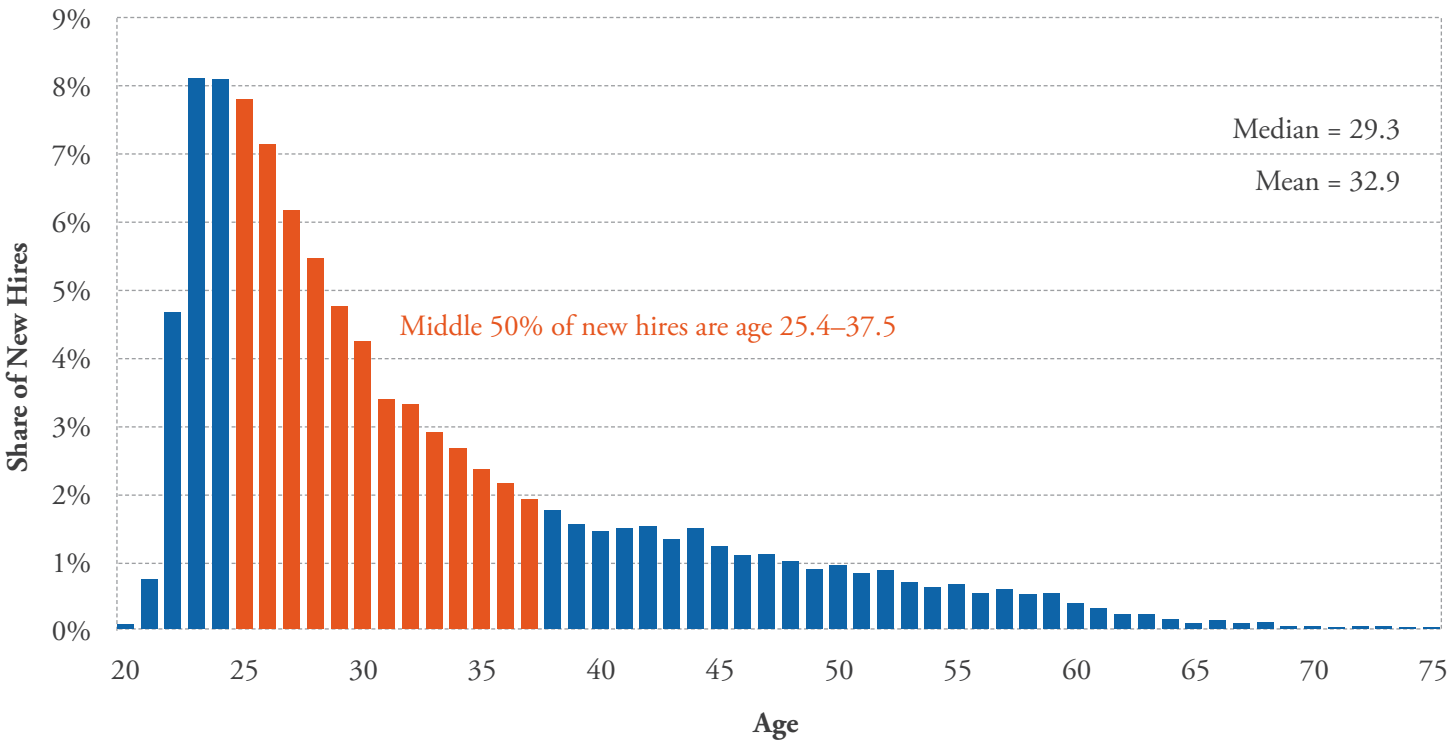
In stark contrast to studies that highlight 25-year-old entrants as representative of new hires, most new-hire teachers in California are significantly older (**Figure 3**). While the distribution of new-hire teachers is indeed skewed toward younger ages compared to the current teaching population, the median age of a new-hire teacher in California is 29.3 years, and the mean is 32.9. The middle half (50%) of entering teachers are between ages 25.4 and 37.5 years old. This means that one-quarter are 25.3 years and younger, and one-quarter are 33.0 years and older.

The exact reasons for the significant presence of mid-career teachers among new hires are unclear, but we suspect two possible factors. One is in-migration of experienced teachers from out of state. While there is no reliable data on inter-state migration of experienced teachers, the fact that approximately 22% of new certifications in 2011–2013 were awarded to teachers trained in other states provides some indication that California is hiring many teachers from out of state.[37]

The other possible factor contributing to the large number of older new hires is teaching as a second career. A proxy for this is the share of initial teaching credentials issued to individuals graduating from alternative programs, relative to traditional programs (e.g., Baccalaureate or Master's programs.) Of the credentials issued to teachers with in-state preparation in 2013, 17% had completed alternative programs and 83% had completed traditional programs. The share of alternative credentials tends to rise during hiring booms, and decline during layoffs. Accordingly, the share of new credentials to those prepared in alternative programs has fallen faster than those prepared in traditional programs since the Great Recession.[38]

Figure 3

Age Distribution of California New Hire Teachers



Note: *Authors' analysis of CalSTRS active membership data as of June 30, 2014.*

TENURE PATTERNS AMONG THE CALIFORNIA TEACHING WORKFORCE

Turnover and Tenure Analysis Methodology

We obtained two tables from CalSTRS: active member counts grouped by age and years of service for fiscal year ended June 30, 2014, and actuarial assumptions—annual rates of separation, retirement, disability, and mortality by age and/or years of service. Both these data sources are granular down to the single-year level, in contrast to data published in actuarial valuations which are aggregated in five-year intervals for age and service.

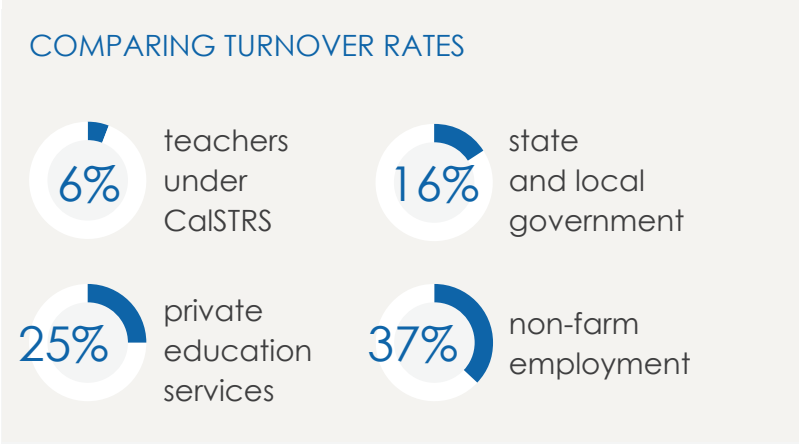
The actuarial assumptions were based on CalSTRS' study of turnover and retirement experience in 2006–2010.[39] Notably, despite the Great Recession, we see no evidence that turnover rates have changed significantly compared to the previous study.[40]

We combined the separation, retirement, disability, and mortality rates to construct a matrix of annual turnover rates contingent on age and accrued number of service years. For instance, we estimated that a 44-year-old female teacher with 21 years of service has a 0.608% chance of separating, dying, or becoming disabled over the next year, and a 0.578% chance during the subsequent year. Using these rates, we constructed survival curves for each age/service cohort in the active membership table, and progressed the active membership counts in each cohort forward until age 75, when CalSTRS actuaries assume all surviving teachers will retire. We assumed that teachers who are currently age 75 or older will retire immediately.

Finally, for the purposes of the retirement benefit analysis in Section IV, we isolated the miniscule share of teachers who are projected to die or become disabled before retirement age from the tenure distribution, in order to count only those who would collect pension benefits.

Turnover Findings

To begin, teachers have a high degree of mobility across school districts, especially during early career. However, due to the portability of CalSTRS benefits across the largest state in the nation, the aggregate turnover rate for teachers under CalSTRS, counting all ages, is approximately 6%.[41] In comparison, the annual turnover rate was 16% for state and local government employment, 25% for private educational services, and 37% for non-farm employment in 2012.[42]



CalSTRS' teacher turnover rate is roughly consistent with national statistics, when portability is taken into account. The National Center for Education Statistics (NCES), which administers the Schools & Staffing Survey/Teacher Follow-Up Survey, reported a 15.6% separation rate in 2008–2009 among public school teachers. About half (7.6% of all teachers) moved to another school, and the rest (8%) were "leavers" who left the profession entirely.[43] Data for 2004–2005 were roughly similar. In a large teaching labor market like California, which encompasses 1,700 school districts, community college districts, county offices of education, Regional Occupational Centers and Programs, and select state agencies and more than 400,000 teaching jobs, most "movers" who switch to another school district would still be covered by CalSTRS. Assuming that only a small percentage of movers leaves the state, the 6% overall annual separation rate among CalSTRS members is somewhat lower than the 8% national "leaver" rate.

Conversely, retention of California teachers within the state as a whole—as reflected by CalSTRS active membership—is remarkably high after the initial churn of the pre-vesting years. California teachers who vest into CalSTRS pension benefits stay in the state, and stay for a long time. **Figure 4** illustrates turnover by entry age. Turnover is highest in the first three to four years after hire, and then decreases dramatically until early retirement age. Indeed, for teachers hired at age 25, the turnover rate for most years between vesting and age 55, when they become eligible for early retirement, is under 1%.

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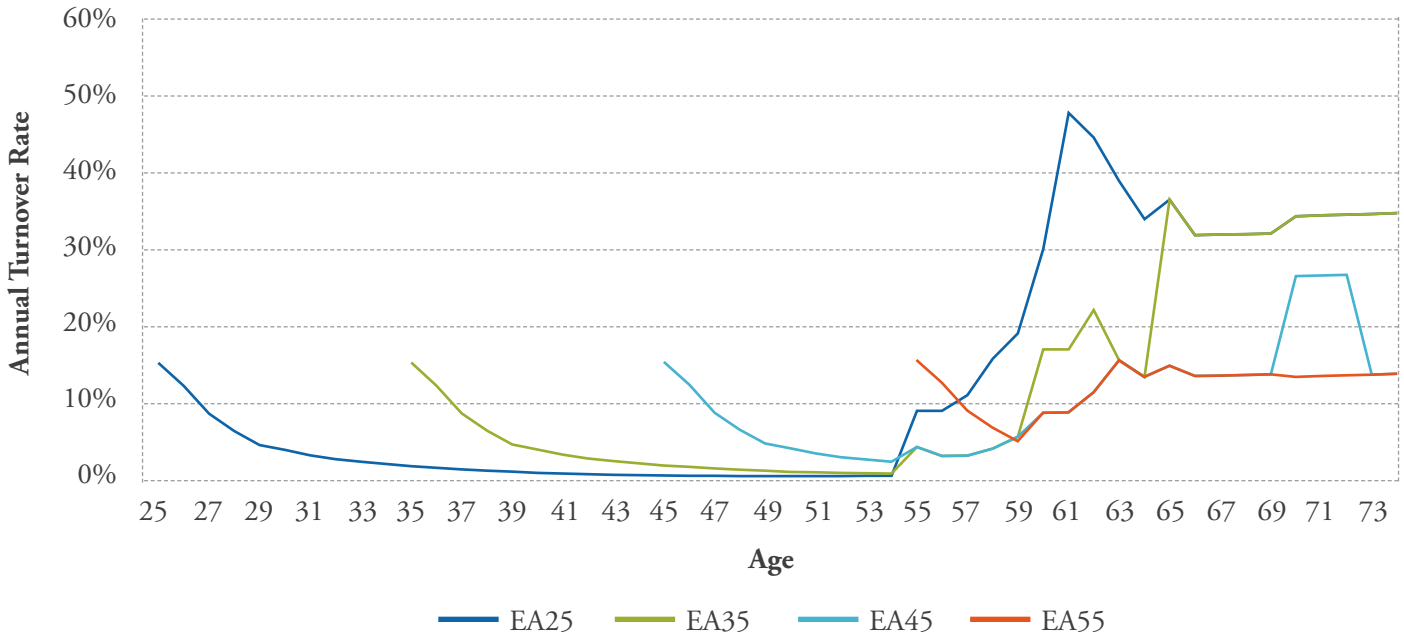
Figure 4

Age-Specific Turnover Rates, by Entry Age



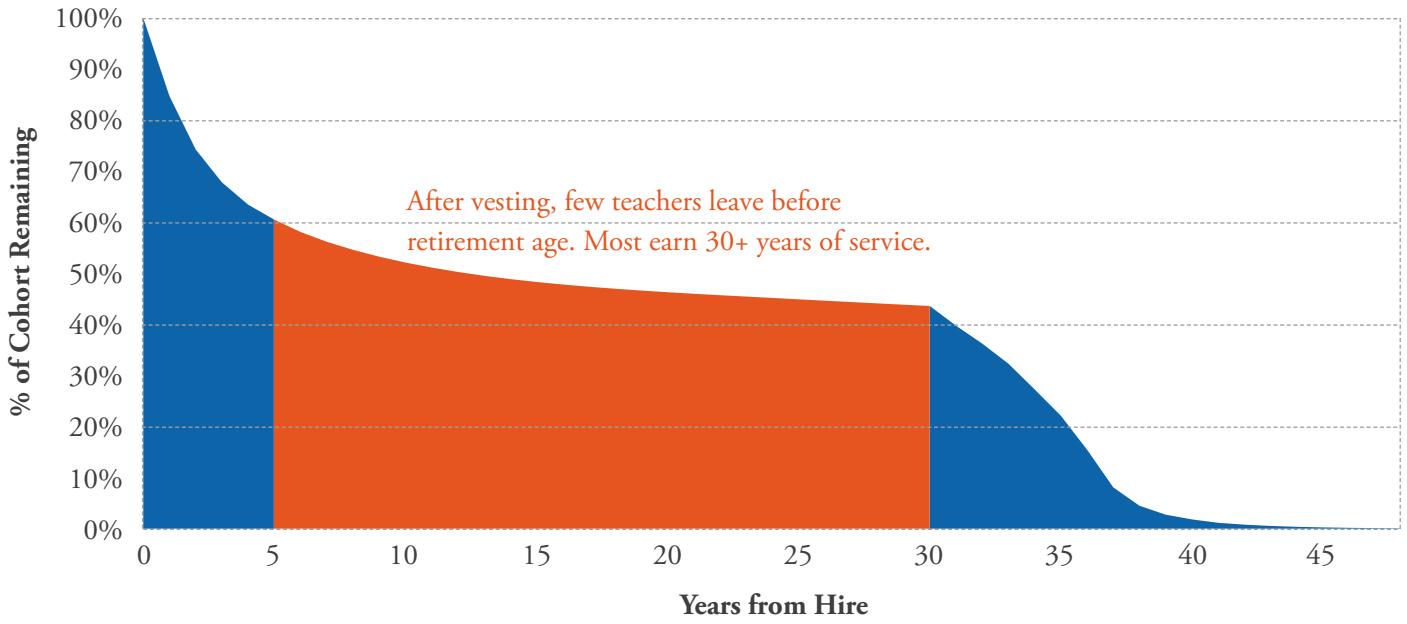
Note: *Authors' analysis of CalSTRS actuarial assumptions. Data reflect weighted average of male and female turnover rates.*

As demonstrated in **Figure 3** above, the majority of actual new entrants are significantly older than 25. But in California, even 25-year-old hires have a significant likelihood of staying for a full career (**Figure 5**). As expected, early turnover is high: two out of every five new hires brought on at age 25 will leave before they can vest at five years of service. Most of this attrition is concentrated in the first three years, when 3 out of 10 original hires will leave. Subsequently, attrition rates continue to drop so that only a small share of teachers leave between their vesting date and the year that they first become eligible to start receiving retirement benefits (five years of service at age 55). In fact, of the teachers who make it to the five-year vesting mark, 72% can expect to retire with at least 30 years of service. This is equal to 44% of the original cohort. According to our turnover and tenure analysis, this pattern—high turnover before vesting, and low turnover until retirement eligibility—applies to new hires across the age spectrum.

[Of] the teachers who make it to the five-year vesting mark, 72% can expect to retire with at least 30 years of service.

Figure 5

Cumulative Retention for Teachers Hired at Age 25



Note: *Authors' analysis of CalSTRS actuarial assumptions. Data reflect weighted average of male and female survival rates.*

Research indicates that early career turnover among teachers is primarily driven by non-economic issues such as career fit and school-level working conditions.[44] In addition, non-tenured teachers face greater job insecurity. New teachers are first in line to receive layoff notices at the end of the school year when the school budget is uncertain, and this may prompt some to seek other employment. Thus it is not clear the extent to which the five-year vesting cliff happens to mirror the point at which teacher attrition stabilizes for reasons not related to pension benefit structure. However, there is a clear link between retirement plan design and employee tenure over the long term: workers in DB plans are more likely to stay until retirement age than workers in 401(k)-style defined contribution (DC) plans.[45]

Tenure Findings

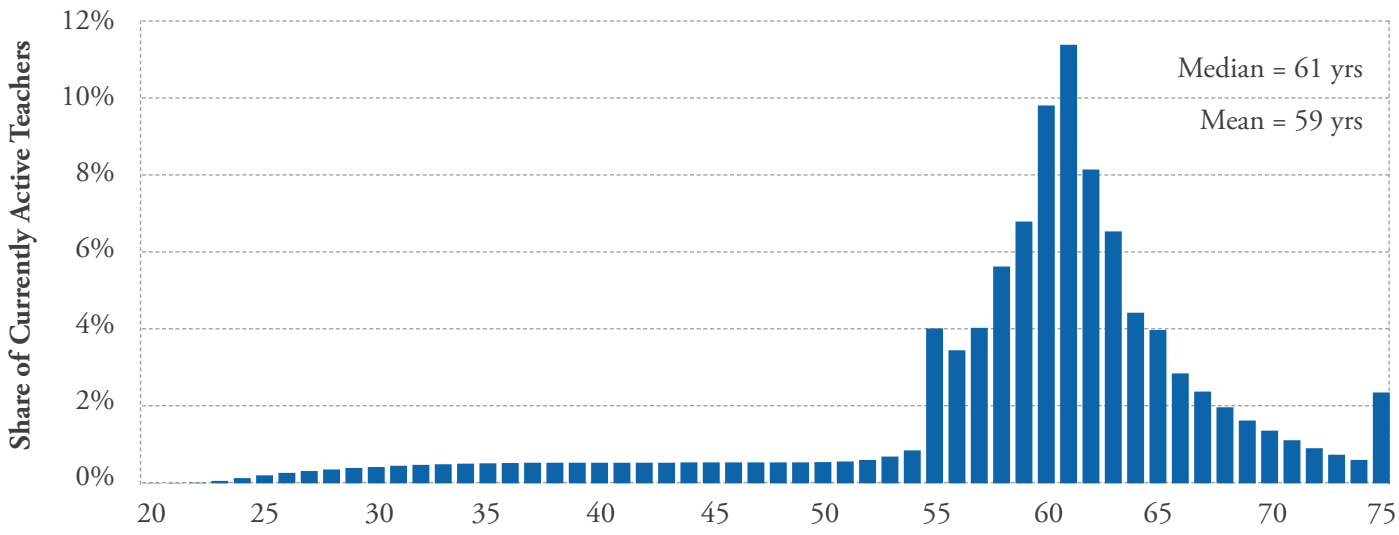
When the career trajectories of the entire active teaching workforce in California are considered, a pattern emerges that has very different implications for the evaluation of retirement benefits than one based solely on new, young hires. To begin, **Figure 6** illustrates the distribution of exit ages among currently active teachers. Before age 55, the shares of the current teaching workforce that will leave each year (as a percentage of the current total) are miniscule—well under 1% annually. The attrition rate jumps to 4% at age 55, the earliest age to collect retirement benefits, and increases to a peak of nearly 12% at age 61—the median age of separation from service. Thereafter, retirement rates accelerate. The vast majority of California teachers (84%) will leave when they are at least 55 years old, with vested benefits.

84%

of California teachers will leave when they are at least 55 years old, with vested benefits.

Figure 6

Projected Age at Exit Among Current California Teachers



Note: *Authors' analysis based on CalSTRS active membership data and actuarial assumptions as of June 30, 2014.*

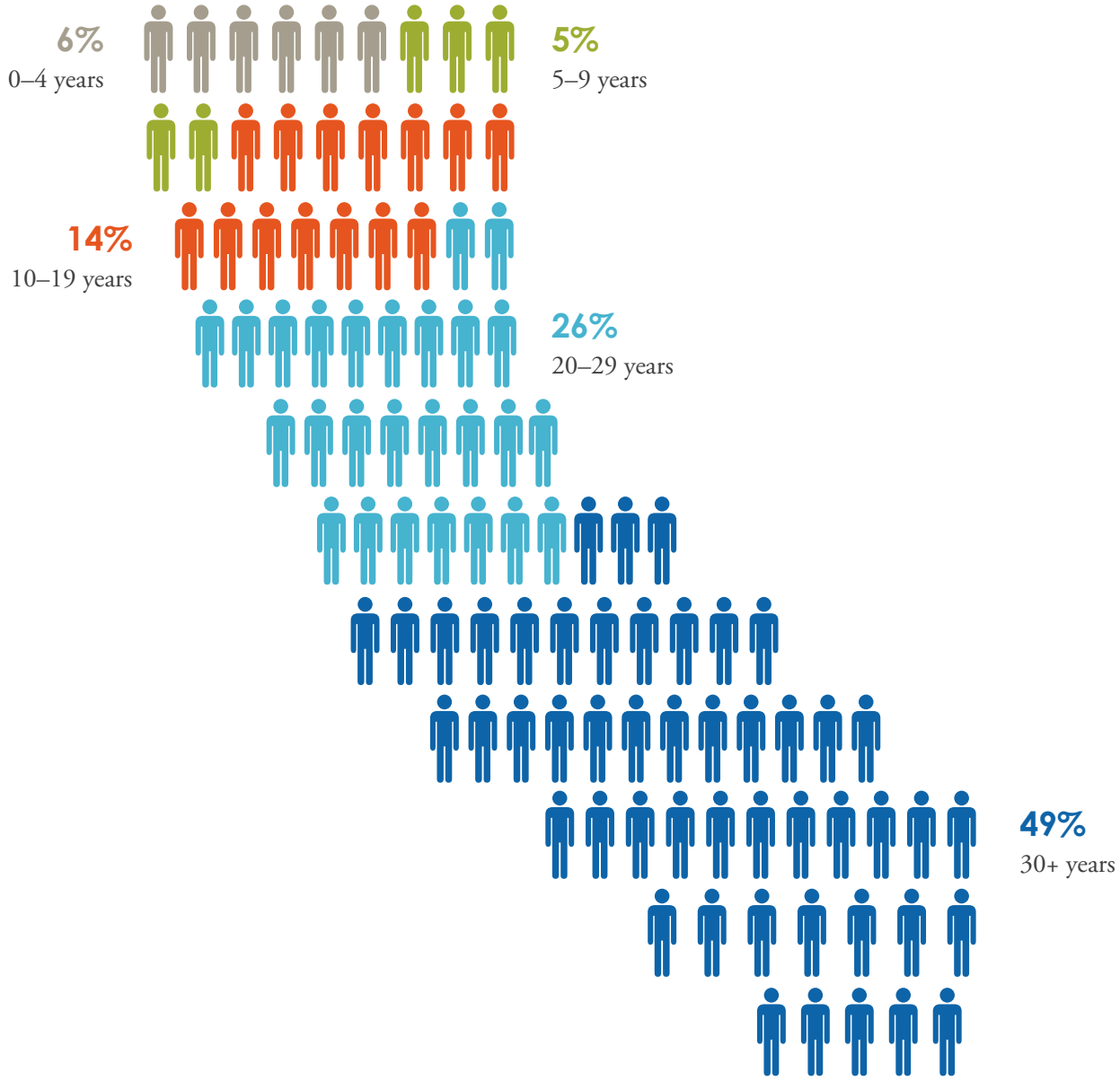
We also analyzed the total years of service that California teachers will have accrued by the time they leave. About half (49%) of the teaching workforce will have earned at least 30 years of service by the time they leave the California schools (**Figure 7**). One-quarter (26%) will leave with 20 to 29 years of service. These add up to 75% of teachers staying at least 20 years. Only 6% will leave without vesting, and 19% will leave with 5–19 years of service.

In summary, a large majority of teaching positions in California public schools are occupied by long-career teachers, not short-term teachers. Most teaching work in California is performed by full-career teachers and those who finish their teaching careers in the state. Only a small percentage of teaching positions are occupied by those who leave before accumulating substantial service, or leave well before retirement age. This has profound implications for the evaluation of alternative retirement benefits in relation to the CalSTRS DB pension, as we demonstrate in the next section.

Most teaching work in California is performed by full-career teachers and those who finish their teaching careers in the state. Only a small percentage of teaching positions are occupied by those who leave before accumulating substantial service, or leave well before retirement age.

Figure 7

Projected Tenure of Current California Teachers



Note: *Authors' analysis based on CalSTRS active membership data and actuarial assumptions as of June 30, 2014.*

IV. MODELING OUTCOMES FROM ALTERNATIVE RETIREMENT BENEFITS

> Six out of seven teachers in California (86%) are better off with the CalSTRS pension than an idealized 401(k).

In this section, we evaluate how defined contribution (DC) or cash balance (CB) plan outcomes for California teachers compare to the CalSTRS defined benefit (DB) pension. The first part of this analysis consists of rigorous benefit modeling that compares benefit outcomes under the three plans, using the same contribution rate. The second part consists of estimating the share of California teachers who are better off in the DB pension, based on the projected exit age and service year accrual, compared to the other plans.

We find that six out of seven teachers in California (86%) are better off with the CalSTRS pension than an idealized 401(k). In addition, four out of five (79%) are better off with the CalSTRS pension than a generously structured cash balance plan.

1. In terms of annual retirement income and total financial value, CalSTRS pension benefits exceed those of an idealized DC plan at age 51 for teachers who have vested by then. The CalSTRS pension exceeds the benefits of a generously structured CB plan at age 56. These cutoffs apply to those hired at younger ages, and occur sooner for those hired at older ages.
2. While it is widely acknowledged that traditional DB pensions generate inequality based on entry and exit dates, with later entrants receiving a proportionally larger benefit, account-based plans tend to generate inequality in the opposite direction. In addition, the investment risk in 401(k)s exposes participants to large-scale, arbitrary inequalities in retirement benefits between teachers with the exact same career trajectory.
3. Indexing final salary to inflation in the DB pension will mitigate the potential loss in benefit, compared to the DC plan, for the small share of teachers who vest but leave before age 52. This is a more elegant solution than a wholesale switch to an account-based plan that would reduce the retirement incomes of most teachers currently teaching in California schools.

BENEFIT MODELING METHODOLOGY

We modeled DC and CB outcomes based on a fixed contribution rate of 14.42% of pay, equal to the current normal cost of the retirement benefits and withdrawal benefits provided under CalSTRS. We also modeled DC benefits based solely on the PEPRA new employee contribution rate of 9.205%, in order to calculate the "break-even" point for employee contributions to the DB plan compared to the DC plan.[46] We used CalSTRS' internal assumptions regarding increases in salary and post-retirement longevity. We also assumed a minimum retirement age of 60. That is, teachers wait until age 60 to start collecting benefits if they separate earlier, and those separating at age 60 or older retire immediately. Finally, retirement benefits in all three plans are taken as a lifetime income equivalent to the CalSTRS pension retirement annuity, which includes a 2% fixed annual cost-of-living adjustment. Further details can be found in Appendix A.

For the DC plan, we used a generous set of financial and behavioral assumptions, and assumed that the employer bears no investment or longevity risk:

Asset allocation and investment returns

All funds are invested in a Target Date Fund, which gradually shifts asset allocation from mostly stocks to mostly bonds as a worker approaches retirement age. The asset allocation glide path that we modeled represents a typical private market Target Date Fund, and the resulting portfolio is aggressive, translating into relatively high returns. We calculated the geometric mean (dollar-weighted) portfolio returns based on the projected average returns and volatility.

Fees

We assumed a low "all-in" expense ratio of 0.25% (25 basis points) for combined investment and administrative costs. This is in line with the average for very large, well-managed plans, but considerably lower than the fees paid by California teachers under the current voluntary 403(b) system.

Participant behavior

In the baseline (idealized) scenario, participants exercise perfect discipline, maintaining the target asset allocation and committing none of the common mistakes made by individual investors, such as pre-retirement loans and withdrawals, chasing returns, and selling off assets during market downturns. For the less optimistic scenario, we assumed a one percentage point reduction in net returns in addition to fees. This is a conservative estimate given that an average of 1.5% of DC plan assets leak out each year, and that individual investor level returns trail the asset classes in which they are invested by an estimated 0.9 to 4 percentage points.[47]

Annuitization

In order to facilitate an apples-to-apples comparison with the DB plan, we assumed that the entire account balance at retirement is used to purchase a private insurance immediate annuity equivalent to the lifetime income stream provided by CalSTRS. In this way, we incorporate the value of the longevity insurance that is one of the key benefits of a DB pension.[48] We assumed a generous interest rate of 5%, which aligns with historical and projected long-term averages, but which significantly exceeds market interest rates in the low-interest, low-inflation financial environment that has persisted since 2008.

For the CB plan, we also assumed a generous guaranteed interest rate of 7%. The employer bears all the investment and longevity risk, but the benefit accrual pattern is similar to a 401(k). That is, a compound annual interest rate of 7% was applied to contributions. We assumed that the plan offered in-plan annuitization at a generous rate of 7%, on terms identical to the CalSTRS pension annuity. (See sidebar, "About Cash Balance Plans," for an explanation of CB plans.)

In the CalSTRS DB plan, the employer bears all investment and longevity risk, and benefit accrual is tied to number of service years, age, and final average salary. We identified the maximum benefit available to teachers upon separation—whether an employee contribution refund with interest, lump sum cash-out, or the pension annuity. Teachers who leave before vesting are eligible only for employee contribution refunds with interest. We assumed that refunds and cash-outs are immediately rolled over into the same Target Date Fund that we modeled for the DC plan.

In addition, we had to create an apples-to-apples measure of retirement benefit value across these three plans for comparison purposes. DB plans express benefits in terms of income replacement—lifetime monthly income as a percentage of final pay—while DC plans and CB plans express benefits as lump sum account balances. In addition, the same account balance will generate different income streams in a DC plan compared to the CB plan that we modeled, because the latter offers a higher interest rate on annuities.

Given that the DC plan is the only plan in which there is an immediate cash value for individual participants, we converted the DB and CB plan benefits to 401(k)-equivalent values. For each year of separation, we identified the projected annuity benefit for the DB plan, and calculated the balance that would be required to fund the same benefit through the DC plan. We repeated the same procedure for the CB plan. In the cases where an employee contribution refund or lump-sum cash-out had the greatest value, we simply used those cash values without adjustment.

Finally, we also calculated replacement rates—retirement income as a percentage of final pay.

ABOUT CASH BALANCE PLANS

Cash balance (CB) plans are retirement plans that combine some of the features of 401(k)s and DB pensions. Like traditional pensions, the employer guarantees benefits, but—unlike a traditional DB pension—those benefits are expressed as lump sum balances rather than a retirement income stream. Furthermore, most CB plans are designed to reduce cost and risk to the employer, resulting in significantly less generous guarantees compared to a traditional pension. Features include the following:

- **Notional accounts**
  Account balances represent funds promised to the employee by the employer, rather than actual assets.
- **Pooled investments**
  Investments are managed by professionals in a pooled trust rather than in individually controlled accounts.
- **Shared risk**
  Investment risk is typically spread between employers and employees, though in some cases the employer bears all the risk. In most cases, the employer guarantees a modest minimum interest rate—usually tied to a market interest index, such as Treasury bonds. Sometimes, additional credits are awarded to employee accounts depending on plan investment performance. In the public sector, the most generous plans offer a guaranteed 7% interest rate until retirement, and 7% interest on an annuity.[49]

The CB plan modeled in this study—which assumes 7% guaranteed interest and 7% interest rate on a life annuity at retirement—is significantly more generous than most real-world plans of this type, and thus presents much better outcomes for teachers than we would expect if teachers currently in CalSTRS were switched to a CB plan. We chose to illustrate the impact of a plan in which the employer bears all the risk, but in which the benefit accrual pattern is similar to a 401(k). However, in most state policy debates regarding pension benefits, CB plans and combined DB/DC hybrid plans are proposed as a way to reduce both the risk and cost to the state, translating into lower benefits.

BENEFIT MODEL FINDINGS

In order to simplify findings across entry ages and plan types, **Figure 8** provides a schematic illustration of benefit accumulation under the DC plan and the CalSTRS DB pension, and the share of current teachers that fall on each side of the crossover point between the two plans. (As we illustrate below, the CB plan follows a similar accrual pattern to the DC plan.)

When benefit accrual patterns are considered in conjunction with projected tenure, we find that six out of seven California teachers will receive higher retirement benefits from the CalSTRS DB pension than they would from an idealized DC plan, taking into account both retirement wealth and retirement income.

Three critical findings contribute to this conclusion:

1. Vested DB pension benefits exceed idealized DC plan benefits at age 51 for teachers who entered at age 25, and earlier for mid-career entrants.
2. Vested DB pension benefits exceed those of a generously structured CB plan at age 56 for teachers hired at age 25, and earlier for mid-career entrants.
3. Based on the tenure analysis described in the previous section, 86% of current teachers will stay until at least age 51—the point at which the DB pension becomes more valuable than an idealized DC plan--with vested benefits. Similarly, 79% will stay until at least age 56, when the DB pension exceeds a generous CB plan or later with vested benefits.

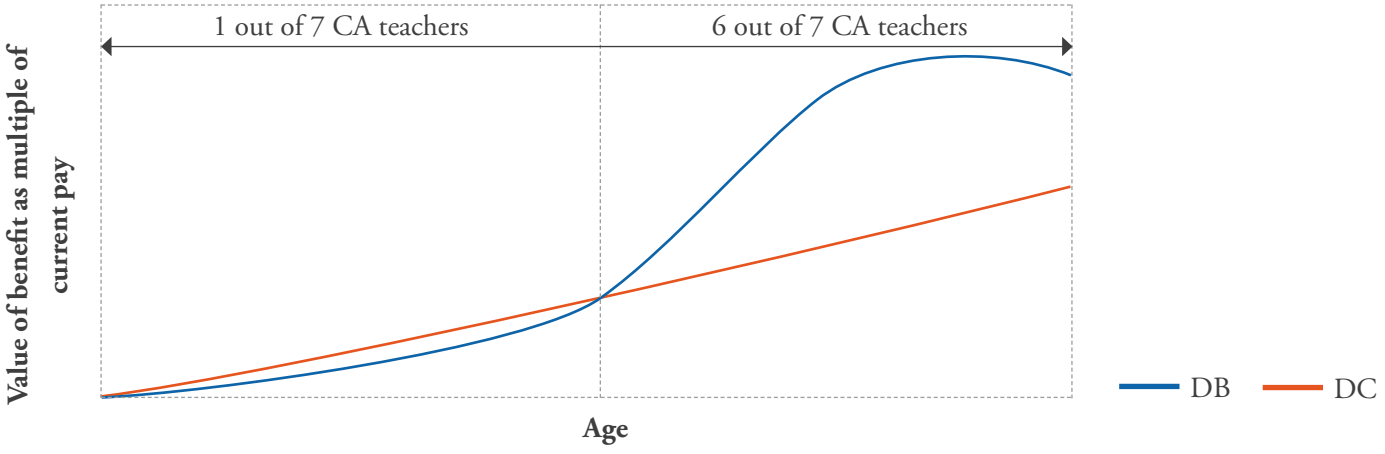
Under the CalSTRS pension, like most plans of its kind, teachers in the beginning of their career accumulate benefits more slowly than they would in a DC plan. Pension accrual begins to accelerate mid-career—e.g., during the early 40s for someone starting at age 25 or 30—so that the annual rate of gain in benefit value exceeds that of the DC plan. That is, the slope of the DB benefit curve becomes steeper than the slope of the DC benefit curve. The total accumulated benefit for the DB plan surpasses the DC plan at age 51 for age 25 hires, and somewhat earlier for those hired at later ages.

Finally, after age 65—the age at which the pension benefit multiplier peaks—the growth of pension benefits as a multiple of current pay flattens out and in some cases becomes negative. Although benefits continue to grow in absolute terms in tandem with salary growth and accumulated service years, this is outstripped by the decrease in the number of years of benefit payments.

As **Figure 8** shows, DC benefits appear to accrue at a steady pace throughout the career. However, as we demonstrate elsewhere in this study, the retirement income purchasing power of each year's contributions is greatest for young workers and smallest for those on the cusp of retirement, even when the contribution rate remains fixed.

Figure 8

Benefit Accumulation under CalSTRS Defined Benefit Pension vs. Idealized Defined Contribution Plan



Benefit accrual comparisons for female teachers entering at age 25, 35, and 45 are illustrated in **Figure 9**, **Figure 10**, and **Figure 11**, respectively. The value of benefits as a multiple of current salary is represented for the DB pension, the idealized DC plan, and the CB plan. In addition, "DC-EE" represents the employee share of retirement contributions, assuming investment in a DC plan.

Data for entry ages in five-year increments from 25 to 45, for both men and women, can be found in Appendix B. While men—who make up 28% of CalSTRS active membership—can expect slightly higher retirement income from a 401(k) compared to women because the former has shorter life expectancy, the fundamental findings remain the same.

Comparing the three charts, three patterns emerge:

- The CalSTRS DB pension becomes more valuable than the idealized DC plan at age 51 for teachers hired at age 25. This transition occurs at age 49 for those hired at age 35 and at age 50 for those hired at age 45.
- The CalSTRS DB pension becomes more valuable than the CB plan somewhat later—at age 56 for those hired at age 25.
- After the crossover points, the DB plan offers significantly higher benefits compared to the idealized DC plan during the years that current teachers are most likely to exit.
- The break-even point on employee contributions—when CalSTRS pension benefits equal or exceed the account value that would have been accrued in the idealized 401(k) if employee contributions were invested in the DC plan—occurs after 20 years of service for age 25 hires, nine years of service for 35-year-old hires, and five years of service for 45-year-old hires.

Figure 9

Value of Benefit—Defined Benefit, Defined Contribution, and Cash Balance Plans
Entry Age 25—Female

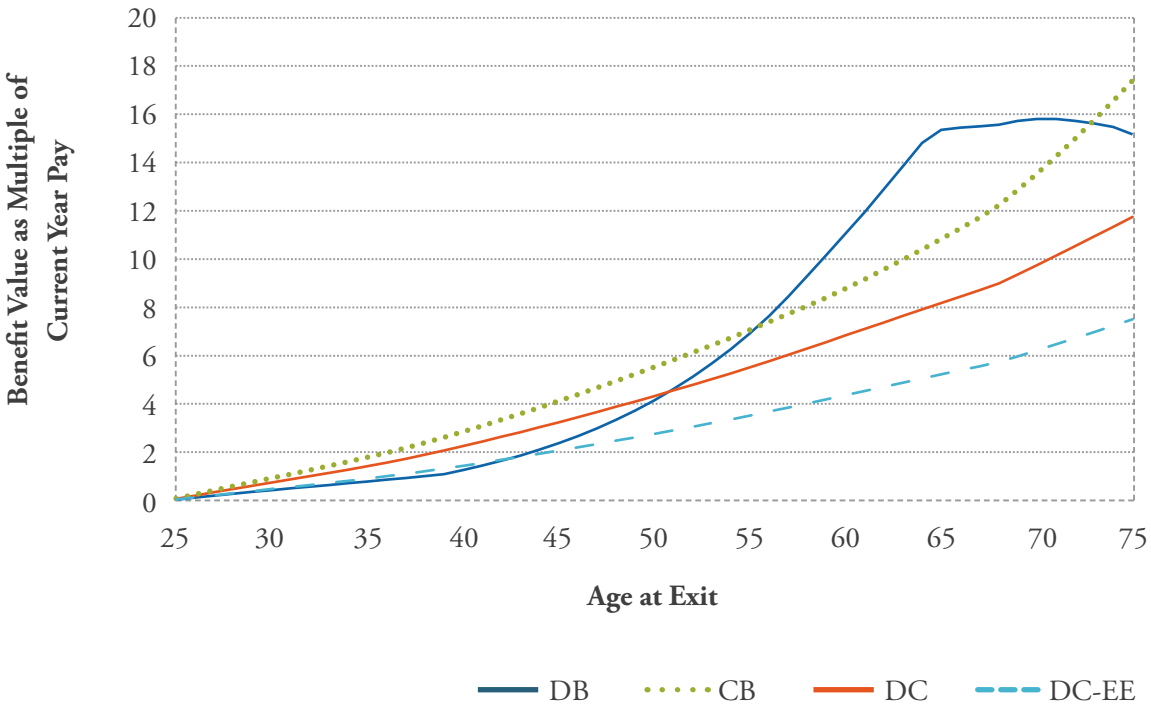


Figure 10

Value of Benefit – Defined Benefit, Defined Contribution, and Cash Balance Plans

Entry Age 35—Female

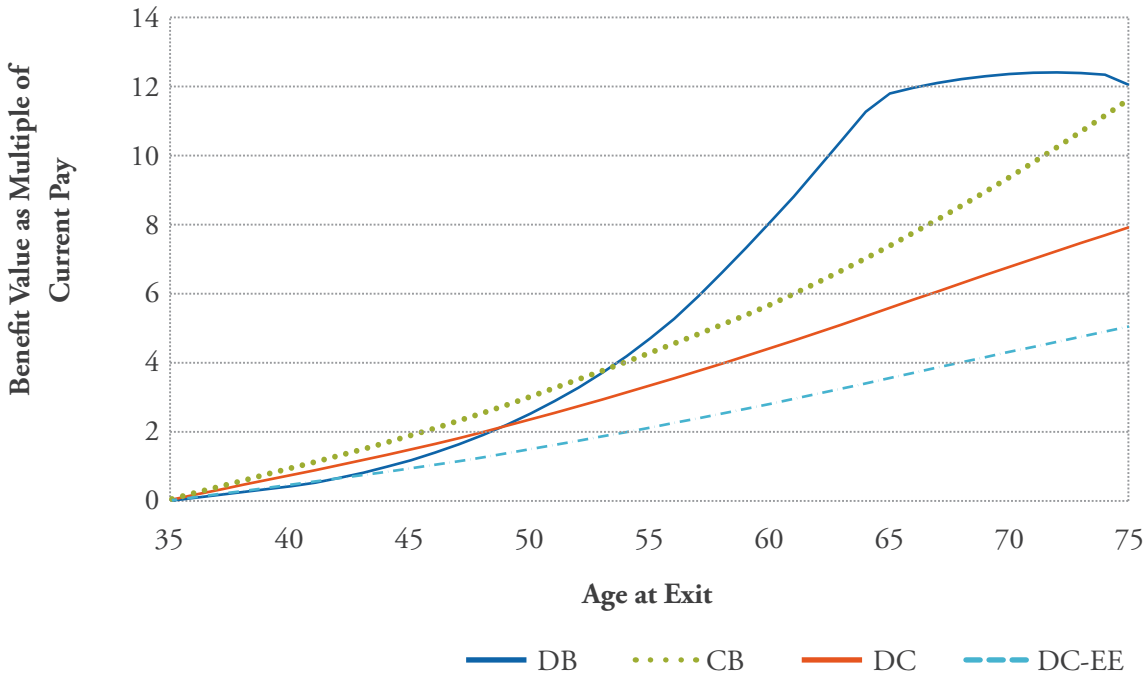


Figure 11

Value of Benefit – Defined Benefit, Defined Contribution, and Cash Balance Plans

Entry Age 45—Female

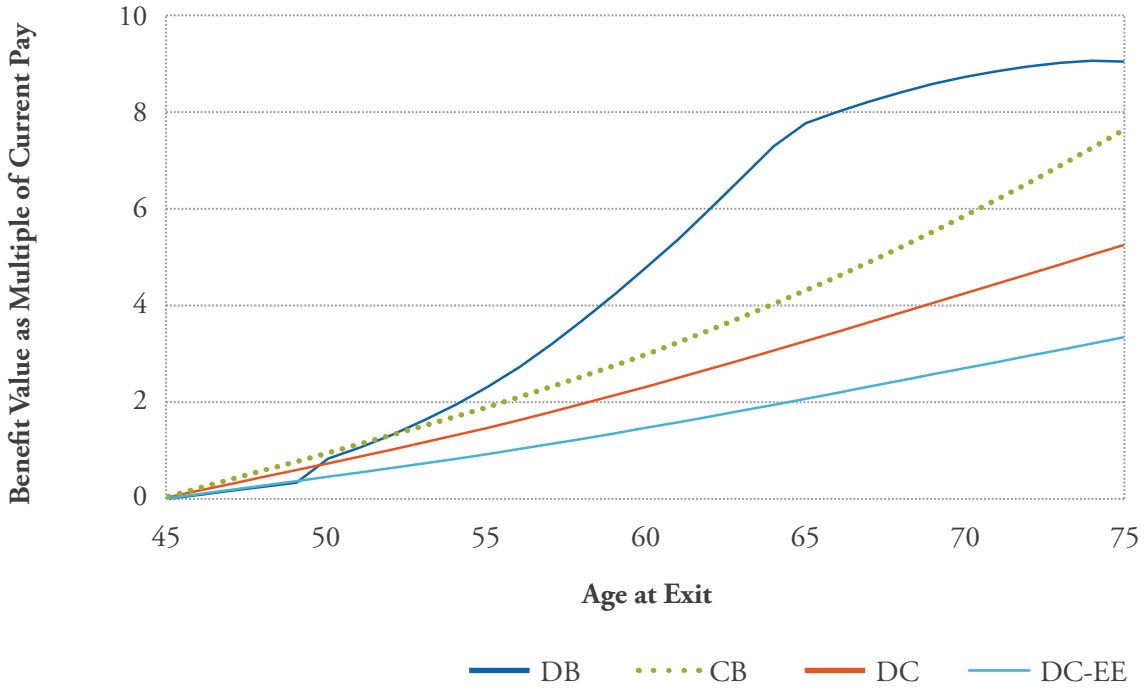


Table 2 summarizes the findings for entry ages 25 to 45 in five-year increments, indicating the age at which the DB plan value exceeds the value of the DC account, and the age at which the DB value exceeds the benefit that would be earned if employees invested their share of contributions in a DC plan. Data are provided for the baseline scenario which assumes that investors gain full projected market returns in the idealized DC plan, as well as a more realistic scenario in which typical individual behavior leads to 1% reduction of annual investment returns due to a combination of pre-retirement withdrawals and adverse investment behavior.

As expected for a traditional pension, younger entrants have to work longer than older entrants until they receive benefits under the CalSTRS DB pension that are greater than what they could earn in an idealized DC plan. Those who start at age 30—close to the average age for new teacher hires—need to work 13 years to recover the value of their contributions and 21 years to surpass potential benefits in a DC plan, *assuming that participants place no additional value on the employer guarantee offered by a traditional pension.* But the greater the value placed by teachers on guaranteed benefits relative to the income provided by a volatile DC plan, the shorter the break-even horizon.

Adding realistic individual savings and investment behavior reduces the number of years that it takes for the DB plan to "break even" with the DC plan, to age 47 for teachers hired at age 25. This also reduces the number of years to recover the full value of their contributions vis-à-vis the DC plan to 13. Again, this assumes that teachers place no value on the guaranteed nature of DB pension benefits.

Table 2

Age When Value of CalSTRS Defined Benefit Pension Exceeds Value of Alternative Plans for Female Teachers, by Entry Age

	ENTRY AGE				
	25	**30**	**35**	**40**	**45**
DC Plan					
Baseline	51	51	49	49	50
Realistic (1% drag on returns from individual investor behavior)	47	48	46	49	50
DC Plan—EE Contributions Only					
Baseline	43	43	42	45	50
Realistic (1% drag on returns from individual investor behavior)	38	39	40	45	50
CB Plan	56	55	54	53	52

Note: *Women make up 72% of CalSTRS active membership. For entry ages 25, 30, and 35, DB value exceeds DC and CB values one year later for male teachers than for female teachers. For entry ages 40 and older, the crossover point is the same for both genders.*

Based on age 25 cutoffs for when the DB value exceeds the value of alternate plans, 86% of active teachers will earn greater retirement benefits from the CalSTRS DB pension than they could expect from an ideal DC plan (**Figure 12**). Similarly, 79% of active teachers are better off with the CalSTRS pension than with a generous CB plan.

Figure 12

Share of California Teachers Who Are Better Off With CalSTRS Defined Benefit Pension

86%

Compared to Idealized Defined Contribution Plan

79%

Compared to Generous Cash Balance Plan

Comparing Retirement Income Outcomes

Table 3 quantifies the magnitude of the difference in replacement rates—benefits as a percentage of final single year pay—for various career trajectories, assuming that everyone begins collecting retirement benefits at age 60.[50] Teachers hired at age 25 who withdraw after 30 years at age 55 and begin collecting DB pension benefits at age 60 will have 40% of their pre-retirement income replaced by CalSTRS, assuming that they found another job with the exact same pay trajectory. Teachers hired at age 30 who withdraw after 30 years and immediately collect their pension at age 60 will have a replacement rate of 50% from CalSTRS. While there is indeed a disparity between the two groups of teachers, even teachers who started at age 25 and withdraw at age 55 would receive pension benefits from CalSTRS that are 21% greater than the benefit they could expect to earn under the DC plan (40% versus 33%). Furthermore, the CalSTRS pension benefit is guaranteed, while the DC plan benefit is not.

Moreover, for the educators who account for the vast majority of teaching positions, the DB plan offers a strong advantage.

Even teachers who started at age 25 and withdraw at age 55 would receive pension benefits from CalSTRS that are 21% greater than the benefit they could expect to earn under the DC plan.

Table 3

Income Replacement at Age 60 for CalSTRS Defined Benefit Pension and Idealized Defined Contribution Plan

			REPLACEMENT RATES	
Entry Age	**Exit Age**	**# Svce Yrs**	**DB**	**DC**
25	30	5	3%	**6%**
25	45	20	17%	**23%**
25	55	30	**40%**	33%
25	60	35	**63%**	38%
30	40	10	6%	**11%**
30	45	15	12%	**17%**
30	55	25	**34%**	28%
30	60	30	**50%**	31%
40	45	5	3%	**5%**
40	50	10	**10%**	9%
40	55	15	**20%**	14%
40	60	20	**34%**	18%
45	50	5	4%	4%
45	55	10	**13%**	8%
45	60	15	**25%**	12%

Highlighted cells indicate groups that make up part of the 86% of active teachers who will leave at age 51 or later and will receive higher income from DB than DC.

Note: *Income replacement rates are annual retirement income as a percentage of final year's salary, assuming uniform pay growth for all teachers. In cases where cashing out of CalSTRS provides higher value than the pension benefit, such as younger hires leaving soon after vesting, the lump sum is assumed to be rolled over into a DC plan. DC account balances at age 60 are converted to an immediate life annuity with 2% simple COLA, similar to the CalSTRS pension benefit. The greater replacement rate value between DB and DC is bolded for each career type.*

Notably, given that California teachers do not receive Social Security, the replacement rates in **Table 3** for full career teachers fall short of the 70% to 85% recommended by financial experts to maintain their standard of living.[51] Thus the California teacher retirement benefit system requires teachers to accumulate substantial assets on their own, through the voluntary DC plan, private savings, or other employment.

ACCOUNTING FOR INVESTMENT RISK AND MARKET VOLATILITY

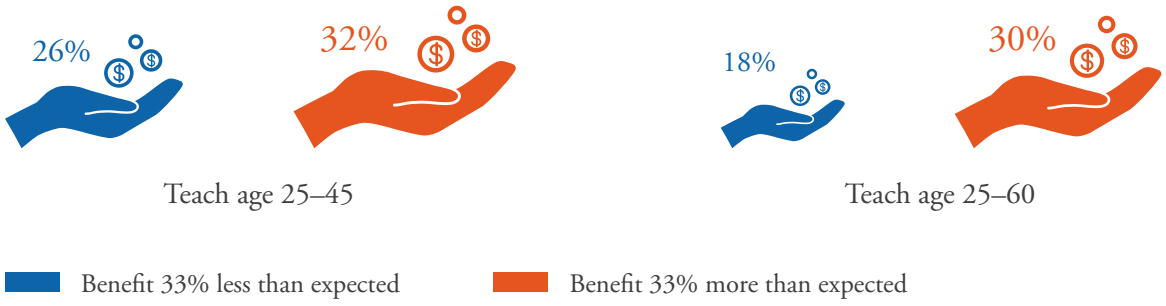
The benefit projections presented above assumed that there was no investment risk or volatility in the DC plan, that is, that every teacher experienced the same investment returns for each asset class. But in the real world, retirement income outcomes vary wildly with financial market swings. In order to measure investment risk and variability of benefits in the DC plan, we ran Monte Carlo simulations of investment returns and applied them to the Target Date Fund portfolio. Monte Carlo simulations involve using statistical parameters from a probability distribution—in this case, the average return and volatility for each asset class such as stocks and bonds, and the correlations between asset class returns—and then drawing a large number of random samples based on these parameters to see which outcomes are the most likely.

The results demonstrate that DC plans entail a wide dispersion of outcomes, such that there are large arbitrary differences among teachers with the exact same career profile. Sample results are shown for 25-year-old hires for two different scenarios in **Figure 13**. In the benefit modeling above, teachers who begin at age 25, exit at age 45, and wait until age 60 to retire are theoretically better off in the idealized DC plan. Our simulations show that they might realize even greater upside: there is a one-in-three chance (32%) that they will have retirement income that is one-third more than expected. On the downside, however, **there is a one-in-four chance that a teacher who starts at age 25 and leaves after 20 years will see a replacement rate of 15% or less from an idealized DC plan. This is less than the 17% guaranteed replacement rate currently provided by the CalSTRS DB pension for this teacher.**

For teachers who start at age 25 and stay until age 60 and retire immediately, the chance of reduced retirement income is smaller (18% chance of having one-third less retirement income than expected from the DC plan). They also have a 30% chance of receiving retirement benefits that are one-third higher than expected. However, for these teachers the guaranteed retirement benefit from CalSTRS is 64% greater (60% replacement rate from DB versus 37% replacement rate expected from DC).[52]

Figure 13

Retirement Income Volatility in a 401(k) Plan



Note: *Simulations based on a typical Target Date Fund and fixed contribution rate. Assume teachers retire at age 60.*

V. CONCLUSION

> Ultimately, switching to an account-based retirement system—such as a 401(k) or cash balance plan—would reduce the overall retirement incomes of California teachers.

Recent studies that pit younger teachers against older teachers, and conclude that a better way to provide retirement benefits is through an account-based retirement plan, inaccurately represent the CalSTRS system on several counts.

First, it is simply misleading to use young, new-hire cohorts to represent the teaching workforce as a whole, without accounting for active teachers of all ages and experience levels. As this study shows, 75% of current California teachers will serve 20 or more years before they leave, and 49% of the total will serve 30 years or more. In addition, mid-career teachers, who stand to particularly benefit from a traditional pension, make up a significant share of new hires. The median projected age of separation or retirement for current teachers is 61.

Early career turnover and retention are serious educational workforce policy concerns that correlate with low compensation and inadequate institutional support, not pension benefit structure. Pitting teachers against each other makes for divisive politics, and does little to address structural challenges to public education that are rooted in the deep historical currents of socioeconomic inequality and deteriorating commitment to public funding for education. Furthermore, the CalSTRS DB pension is more likely to contribute to retention than an account-based plan such as a a defined contribution (DC) plan like a 401(k) or a cash balance (CB) plan.

Second, the statement that younger teachers are subsidizing the benefits of older teachers reflects a misunderstanding of pension funding practice—especially when full-career workers make up half of the California teaching workforce. To the extent that redistribution takes place within a final average salary DB pension, it is more accurate to say that the employer contribution portion of the plan's normal cost is allocated toward those who stay a long time within the same hire cohort. In addition, the DB pension provides all vested employees with guaranteed income as the main benefit, and empirical evidence in states that provide a choice between plan types suggests new hire teachers value a guaranteed pension over 401(k)-style and hybrid plans.

Ultimately, switching to an account-based retirement system—such as a 401(k) or cash balance plan—would reduce the overall retirement incomes of California teachers. Switching to a DC or CB plan would increase retirement benefits for teachers who account for a small portion of teaching positions, while causing sharp benefit decreases for the large majority responsible for educational labor (six out of seven for DC and four out of five for CB). A more equitable solution would be to inflation-index final pay for benefit calculation purposes, in order to mitigate the erosion in benefit currently experienced by those who leave before retirement age. Finally, given that CalSTRS members are not covered by Social Security, switching to a 401(k)-style plan would also mean the loss of teachers' only source of secure retirement income, with negative consequences for teachers across the age spectrum and added cost to societal safety nets for the low-income, elderly population.

[1] CalSTRS, 2015, "Fast Facts: Fiscal Year Ended June 30, 2014," CalSTRS, Sacramento, CA.

[2] See for example R.W. Johnson and B. Southgate, 2015 (Apr.), "Are California Teacher Pensions Distributed Fairly?," Urban Institute, Washinton, DC, http://www.urban.org/sites/default/files/alfresco/publication-pdfs/2000172-Are-California-Teacher-Pensions-Distributed-Fairly.pdf; J. McGee and M. Winters, 2013 (Sep), "Better Pay, Fairer Pensions: Reforming Teacher Compensation," Manhattan Institute, http://bellwethereducation.org/sites/default/files/BW_PensionPaper_031314.pdf; C. Aldeman and A.J. Rotherham, 2014, "Friends without Benefits: How States Systematically Shortchange Teachers' Retirement and Threaten Their Retirement Security," Bellwether Education Partners, http://bellwethereducation.org/sites/default/files/BW_PensionPaper_031314.pdf.

[3] Johnson & Southgate, op cit.; J. McGee and M. A. Winters, "Modernizing Teacher Pensions," *National Review*, n22, 2015, http://www.nationalaffairs.com/publications/detail/modernizing-teacher-pensions.

[4] R. Hanna and K. Pennington, 2015 (Jan. 8), "Despite Reports to the Contrary, New Teachers Are Staying in Their Jobs Longer," Center for American Progress, https://www.americanprogress.org/issues/education/news/2015/01/08/103421/despite-reports-to-the-contrary-new-teachers-are-staying-in-their-jobs-longer/.

[5] CalSTRS, n.d., "Retirement Benefits," http://www.calstrs.com/retirement-benefits, accessed November 5, 2015.

[6] Ibid.

[7] This portion of the total contribution rate excludes sick leave.

[8] CalSTRS, 2015 (Mar. 6), "CalSTRS Valuation Fact Sheet," http://www.calstrs.com/sites/main/files/file-attachments/2014_valuation_fact_sheet.pdf.

[9] CalSTRS, n.d., "CalSTRS 2014 Funding Plan: Overview of AB 1469," http://www.calstrs.com/sites/main/files/file-attachments/calstrs_2014_funding_plan.pdf, accessed November 5, 2015.

[10] Ibid.

[11] CalSTRS, n.d., "Defined Benefit Supplement Program," http://www.calstrs.com/defined-benefit-supplement-program, accessed November 5, 2015. Depending on the school district, part-time and temporary teachers can choose whether to contribute to a second cash balance plan operated by CalSTRS called the Cash Balance Benefit Program, Social Security, or the DB pension. The range of choices depends on the school district. Employee contributions, generally 4%, are matched by employers. CalSTRS, "Cash Balance Benefit Program," http://www.calstrs.com/cash-balance-benefit-program, accessed November 5, 2015.

[12] R.L Clark and D.P. Richardson, 2010 (Nov.), "Who's Watching the Door? How Controlling Provider Access Can Improve K–12 Teacher Retirement Outcomes," TIAA-CREF Institute Research Dialogue, no. 98.

[13] In 1954 the Social Security program was amended to make coverage available to public employees covered by a state plan, who were previously excluded from the program. The choice was up to the states, subject to a majority vote of the members of the plan. In 1955 the California Teachers Association held an every-member vote that resulted in the rejection of Social Security.

[14] A. Munnell, 2005 (Jun.), "Mandatory Social Security Coverage of State and Local Workers: A Perennial Hot Button," Issue in Brief No. 32, Center for Retirement Research at Boston College, Chestnut Hill, MA, http://crr.bc.edu/wp-content/uploads/2005/06/ib_32.pdf.

[15] Social Security Administration GPO Calculator, https://www.ssa.gov/planners/retire/gpo-calc.html.

[16] CalSTRS, "Fast Facts for Fiscal Year Ended June 30, 2014," January 2015, http://www.calstrs.com/sites/main/files/file-attachments/fastfacts_2014.pdf.

[17] J. Hacker, 2008, *The Great Risk Shift: The New Economic Insecurity and the Decline of the American Dream*, Oxford University Press, Oxford & New York; A. Munnell, 2004, *Coming Up Short: The Challenge of 401(k) Plans*, Brookings Institution Press, Washington, DC.

[18] R. Merton, 2014, "The Crisis in Retirement Planning," *Harvard Business Review* v92n7/8, pp. 43–50 .

[19] F. Porell and D. Oakley, 2012, "The Pension Factor 2012: The Role of Pensions in Reducing Elder Economic Hardships," National Institute on Retirement Security, Washington, DC, http://www.nirsonline.org/storage/nirs/documents/Pension%20Factor%202012/pensionfactor2012_final.pdf.

[20] Hacker, op. cit.; N. Sabadish and M. Morrissey, 2013 (Sep.), "Retirement Inequality Chartbook," Economic Policy Institute, Washington, DC, http://www.epi.org/publication/retirement-inequality-chartbook/; R. Hiltonsmith, 2010, "The Failure of the 401(k): How Individual Retirement Plans are a Costly Gamble for American Workers," Demos, New York, NY; K. Miller, D. Madland, and C. Weller, 2015 (Jan.), "The Reality of the Retirement Crisis," Center for American Progress, Washington, DC, https://cdn.americanprogress.org/wp-content/uploads/2015/01/RetirementCrisis1.pdf.

[21] See for example Merton, op cit.

[22] Hanna & Pennington, op cit.

[23] National Commission on Teaching and America's Future, 2007, "The High Cost of Teacher Turnover," http://nctaf.org/wp-content/uploads/NCTAFCostofTeacherTurnoverpolicybrief.pdf

[24] C. Weller, 2011 (Sep.), "Buyer Beware: The Risks to Teacher Effectiveness from Changing Retirement Benefits," Center for American Progress, Washington, DC, https://cdn.americanprogress.org/wp-content/uploads/issues/2011/09/pdf/buyer_beware.pdf

[25] As institutional investors that can tolerate less liquid investments, DB pensions also have access to alternate investments—such as private equity—that generate higher returns than public equities.

[26] See W.B. Fornia and N. Rhee, 2014 (Dec.), "Still a Better Bang for the Buck: Update on the Economic Efficiencies of Pensions," National Institute on Retirement Security, Washington, DC, http://www.nirsonline.org/storage/nirs/documents/Still%20a%20Better%20Bang/bangforbuck_2014.pdf.

[27] Fornia & Rhee, op cit.; Teacher Retirement System of Texas (TRS), 2012, "Pension Benefit Design Study," TRS, Houston, TX; Colorado Office of the Auditor/Gabriel Roeder Smith, 2015 (Jun.), Colorado Public Employees' Retirement Association Hybrid Defined Benefit Plan," GRS, Denver, CO.

[28] Two such reports include J. VanDerhei, 2015 (Oct.), "How Does the Probability of a "Successful" Retirement Differ Between Participants in Final-Average Defined Benefit Plans and Voluntary Enrollment 401(k) Plans?," EBRI Notes v36n10, pp. 9–23, https://www.ebri.org/pdf/notespdf/EBRI_Notes_10_Oct15_HlthSvgs_DB-DC.pdf; a report published by TIAA-CREF Institute in November 2013 titled "Equivalent Cost for Equivalent Benefits: Primary DC Plans in the Public Sector," which was pulled from their website following criticism about the report's flawed assumptions.

[29] D. Goldhaber and C. Grout, 2014, "Which Plan to Choose? The Determinants of Pension System Choice for Public School Teachers," CEDR Working Paper 2014-1, University of Washington, Seattle, WA,; and D. Goldhaber and C. Grout, 2014, "Finding Common Ground In Pension Reform: Lessons from the Washington State Pension System," Bellweather Education Partners, Sudbury, MA.

[30] For a critical analysis of the Washington state case study, see D. Oakley and I. Boivie, 2014 (Dec.), "Teacher Retirement Plans: Case Studies in Washington and Ohio Indicate Value of Pensions," National Institute on Retirement Security.

[31] Oakley and Boivie, op cit.

[32] Oakley and Boivie, op cit.

[33] National Institute on Retirement Security, 2014 (Feb.), "Case Studies of State Pension Plans that Switched to Defined Contribution Plans," National Institute on Retirement Security, Washington, DC.

[34] This study does not distinguish between part-time and full-time service for the purposes of determining final tenure. For instance, a half time career over 30 years is still considered a 30 year career. However, our subsequent analysis of how teachers fare under the DB plan compared to alternative plans takes into account longer vesting for part-time teachers.

[35] Authors' analysis of U.S. Census Bureau/U.S. Bureau of Labor Statistics, Current Population Survey, from S. Flood, M. King, S. Ruggles, and J.R. Warren, 2014, Integrated Public Use Microdata Series, Current Population Survey: Version 4.0. [Machine-readable database], University of Minnesota, Minneapolis, MN.

[36] R. Ingersoll, L. Merrill, and D. Stuckey, 2014, "Seven Trends: The Transformation of the Teaching Force," CPRE Report #RR-80, Consortium for Policy Research in Education, Philadelphia, PA, http://www.cpre.org/sites/default/files/workingpapers/1506_7trendsapril2014.pdf.

[37] U.S. Department of Education, 2014, "2014 Title II Report," https://title2.ed.gov/Public/Home.aspx.

[38] See California Commission on Teacher Credentialing, 2014 (Oct.), "Annual Report Card: California Teacher Preparation Programs for the Academic Year 2012-2013 as Required by Title II of the Higher Education Act," http://www.ctc.ca.gov/commission/agendas/2014-10/2014-10-3d.pdf.

[39] We received detailed actuarial assumptions from Milliman based on the last experience study. Summary findings are available at N. Olleman, N. Collier, and J.D. Sorensen, 2012 (Feb. 12), "California State Teachers' Retirement System Experience Analysis, July 1, 2006 – June 30, 2010," Milliman, Seattle, WA, http://www.calstrs.com/sites/main/files/file-attachments/actuarial_experience_analysis_2010.pdf.

[40] M.O. Johnson and N.J. Collier, 2008 (Mar. 18), "2007 Actuarial Experience Analysis," Milliman, Seattle, WA, http://www.calstrs.com/sites/main/files/file-attachments/exp_study_2007.pdf.

[41] Turnover rate for active CalSTRS membership as of June 30, 2014, based on authors' analysis using CalSTRS actuarial assumptions.

[42] K.C. Hathaway, 2013(May), "Job openings continue to grow in 2012, hires and separations less so," *Monthly Labor Review*, pp.17–35, Table 6, http://www.bls.gov/opub/mlr/2013/05/art2full.pdf.

[43] National Center for Education Statistics, Schools & Staffing Survey, https://nces.ed.gov/surveys/sass/.

[44] Ingersoll, Merrill & Stuckey, op cit.

[45] A.H. Munnell, J.P. Aubrey, J. Hurwitz and L. Quinby, 2012 (Dec.), "How Retirement Provisions Affect Tenure of State and Local Workers," State and Local Pensions # 27, Center for Retirement Research at Boston College, Chestnut Hill, MA.

[46] Employee contributions were lower than 9.2% for the first two years, consistent with CalSTRS' benefit projections which reflect the phasing in of member rate increases starting 2014.

[47] See R. Kinnel, 2014 (Feb. 27), "Mind the Gap 2014," Morningstar Advisor, http://www.morningstar.com/advisor/t/88015528/mind-the-gap-2014.htm. For an overview of research on individual investor behavior and underperformance, see B. Barber and T. Odean, 2011 (Sep.). "The Behavior of Individual Investors," Working Paper, http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1872211. See also N. Tang, O. Mitchell, and S. Utkus, 2011, "Trading in 401(k) Plans During the Financial Crisis," PRC Working Paper 2011-11, Pension Research Council, Philadelphia, PA.

[48] If an individual were to forgo the annuity, they would still have to pace their annual withdrawals to last well past average life expectancy, or else run a large risk of running out of money.

[49] Texas County and District Retirement System offers 7% guaranteed interest during the accumulation phase and a 7% life annuity during the payout phase. Pew Charitable Trusts, 2014 (Feb.), "Public Cash Balance Plans: A Primer," Pew Charitable Trusts, Washinton, DC.

[50] We use the final (and highest) single year of salary as the denominator. As a result, our replacement rate estimates are lower than those that would result if we used the 2% at 62 benefit multipliers on the highest three years of pay, as CalSTRS does for teachers hired after 2012.

[51] Aon Consulting, 2008, "Replacement Ratio Study: A Measurement Tool for Retirement Planning," http://www.aon.com/about-aon/intellectual-capital/attachments/human-capital-consulting/RRStudy070308.pdf.

[52] There is also a small chance that teachers who vest and stay until at least age 51—the cutoff after which CalSTRS DB pension benefits exceed the expected value from the idealized DC plan—might be better off the DC plan under favorable market conditions. But it is doubtful that such teachers would trade their guaranteed benefits for a chance to "win big" in the market.

APPENDIX A: METHODOLOGY

BENEFIT MODELING

In order to compare Defined Benefit (DB) plans, Defined Contribution (DC) plans and Cash Balance (CB) plans, it is necessary to analyze them either in terms of retirement benefits provided or the value of those benefits. DC plans are "defined" in terms of the contribution made to a plan each year. This is the value of the pension benefit because at retirement, the DC account is used to purchase or pay oneself a retirement benefit. As an example, the annual DC contribution is 14.42% (to be discussed below) of pay, and the account balance grows each year with investment income plus annual contributions.

DB plans are "defined" in terms of benefits provided. For example, the annual benefit earned for a year of service might be 2% of average pay.

Because DB plans are defined in terms of benefits and DC plans are defined in terms of contributions, it is not straightforward to compare the two. Either a DB plan benefit must be converted into a present value or a DC plan account value must be converted into an annual benefit. Fortunately, actuarial science is designed to make such conversions. CB plans are best analyzed by converting the cash balance into an annual pension benefit, then converting that benefit back into a present value. Depending on how the CB plan is designed, the actual cash balance might be higher or lower than the necessary DC account balance necessary to purchase the annuity under the CB plan.

This research analyzes DB, DC, and CB both on an annual benefit basis and on a present value basis. The actuarial methodology is as follows.

General Projection Model Approach

Our analysis examined ten illustrative newly hired teachers. They were both male and female, hired at ages 25, 30, 35, 40 and 45. We used Milliman's (the CalSTRS consulting actuary) assumptions for increases in salary and for post-retirement longevity. These actuarial assumptions are identified later in this appendix.

For DC benefits, the accounts are assumed to grow at investment return rates based on various asset allocations which vary by age. Gross returns were decreased by 0.25% for administrative expenses. The annual DC and CB total contributions were calculated to be 14.42% of pay. This is based on the normal cost of the retirement benefits and withdrawal benefits provided under CalSTRS. The CB balance is assumed to grow with 7% investment credit each year.

DB Benefit Amounts

The CalSTRS DB plan provides retirement benefits under a formula. Our analysis simply applies this formula to the demographic characteristics of various illustrative participants. For illustrative members who terminate after age 60, the methodology is to simply calculate the benefit payable at retirement (termination). The CalSTRS formula at age 62 for those hired on or after January 1, 2013 is 2% of the highest three-year average compensation. For example, for someone hired at 25 who retires at 62 would have a pension benefit of 74% x their average compensation.

DC Values

The other key value which is calculated in a straightforward manner is the account balance under a DC plan. As discussed above, our methodology is simply to bring forward the account balance each year with anticipated investment return and additional 14.42% of pay contributions.

DC Benefit Amounts

Because DB and DC are defined in terms of benefits and contributions, respectively, it is necessary to actuarially translate account values into benefit amounts or benefit amounts into account values. To convert a DC account value into a benefit amount, we assumed that the account balance would be annuitized based on a 5% discount rate and the same CalSTRS specific mortality table upon which the normal cost was based. For termination dates prior to age 60, we assumed that the balance continued to grow at the specified interest rates and was converted at age 60. For termination ages 60 and later, we assumed that they were retiring immediately.

CB Benefit Amounts

The cash balance plan we modeled has the following characteristics:

- Cash Balance notional account accruals of 14.42% of pay, to match the DC contribution.
- Annual crediting rate of 7% on cash balance notional account.
- Conversion to annuity payment based on 7% and unisex mortality table based on CalSTRS-specific assumptions and approximately 71.7% female and 28.3% male, which matches the current CalSTRS active teacher population.

Based on these parameters, the CB account balance at the year of termination is projected forward to age 60 if under 60. Like DC, retirement is assumed to take place at the later of the date of termination or age 60. The CB account is then converted to an actuarially equivalent annuity as described above.

CB Values

To determine the value of future benefits under a CB plan, we did not simply use the CB notional account balance. Because of the favorable annuity conversion features under our CB plan, the value of future benefits is generally higher than the actual CB notional account balance. To calculate the value of the CB plan, the annuity determined above was converted back to a present value using the same methodology as used in converting DC present values (account values) into lifetime annuity benefits.

DB Values

Like CB, we calculated the value of the future DB annuity benefits based on the annuity conversion factors necessary to convert DC balances into lifetime annuity payments: 5% returns and CalSTRS-specific sex-distinct mortality tables.

Benefit Forms

In all calculations, we assumed the benefits were payable as a single life annuity with cost-of-living-adjustments (COLAs) similar to the CalSTRS DB procedure. The COLA is a 2% simple interest increase on September 1 following the first anniversary of retirement, applied to all continuing allowances.

STOCHASTIC ANALYSIS

At the authors' request, Milliman (the CalSTRS consulting actuary) ran 1,000 return simulations for each of the asset classes in the Target Date Fund (TDF) portfolio, spanning 50 years. The mean returns, standard deviations, and correlations between asset classes were based on the firm's latest capital market assumptions, and are generally consistent with the assumptions used by the CalSTRS pension plan.

We used the stochastic returns to simulate 1,000 portfolio returns for the DC plan using the TDF asset allocation glide path. We then calculated the median, 75th percentile, and 25th percentile outcomes for key entry and exit ages as an indication of investment risk, and of the potential inequality in outcomes across cohorts.

ACTUARIAL ASSUMPTIONS

Investment Return Assumptions

DB Plan net investment return: 7.5%

DC Plan gross investment return: Schedule based on asset allocation, which is based on hypothetical target date fund (TDF) based on age of member. The TDF asset allocation glidepath reflects a a composite of Vanguard and Fidelity target date fund series. Portfolio geometric mean returns were calculated from capital market assumptions provided by Milliman, consisting of arithemetic mean returns, volatility, and correlations between asset classes.

Sample rates are:

Age	Rate of Gross Investment Return
Age 36 and younger	7.55%
Age 41	7.47%
Age 46	7.36%
Age 51	7.16%
Age 56	6.92%
Age 61	6.67%
Age 66	6.30%
Age 71	5.86%

The DC net investment return rates are reduced from the gross rates shown above by 25 basis points (0.25%) to reflect efficient DC expenses.

Mortality Assumptions

Motality assumptions are used for the conversion of an account value to annuity benefit. These are based on the CalSTRS standard mortality tables for retirees, which is based on historical experience studies. For cash balance plan conversions, which—unlike insurance companies—cannot vary the rate based on sex, we assume that the mortality rates were weighted 71.7% female and 28.3% male. The following table shows representative mortality rates:

Age	Male Annual Mortality Rate	Female Annual Mortality Rate
60	0.24%	0.18%
70	0.91%	0.68%
80	2.82%	2.14%
90	11.06%	8.82%
100	28.52%	21.84%
110	40.00%	33.74%
120	100.00%	40.00%

Salary Growth Assumptions

Salaries are assumed to grow at 3.75% (inflation plus 0.75%), plus a merit component based on age at hire and years of service. The merit based salary components are illustrated in the table below:

Year	Age at Hire					
	Under 25	25–29	30–34	35–39	40–44	45 & up
1	5.6%	5.3%	5.1%	4.8%	4.8%	3.5%
2	5.6%	5.1%	4.9%	4.7%	4.7%	3.3%
3	5.6%	5.0%	4.8%	4.6%	4.6%	3.0%
4	5.5%	4.8%	4.6%	4.4%	4.4%	2.9%
5	5.5%	4.8%	4.5%	3.8%	3.8%	2.6%
10	3.2%	3.0%	2.7%	2.3%	2.2%	1.6%
15	1.5%	1.5%	1.4%	1.1%	1.1%	0.8%
20	1.3%	1.1%	1.1%	0.8%	0.8%	0.6%
25	1.1%	0.9%	0.8%	0.5%	0.5%	NA
30	0.9%	0.7%	0.6%	0.5%	NA	NA
35	0.8%	0.7%	0.6%	NA	NA	NA
40	0.8%	0.6%	NA	NA	NA	NA
45	0.8%	NA	NA	NA	NA	NA

For example, a teacher hired at age 27 is assumed to have a salary increase of 3.75%+5.3%=9.05% in the first year, 8.85% in the second year, and 6.75% in the tenth year. Note that the underlying annual inflation rate is 3.00%, which is the same rate that is used to develop the nominal investment return rates of 7.50% for the DB plan and varying rates for the DC plan. The corresponding real salary increases are thus 6.05%, 5.85%, and 3.75%, respectively.

Other Actuarial Assumptions

In addition to the assumptions identified above, CalSTRS uses a variety of actuarial assumptions in order to determine the total Normal Cost for the DB plan. These are disclosed in various CalSTRS actuarial reports and while not explicitly used in our analysis, are fundamental in CalSTRS determination of 14.42% as the normal cost for retirement and withdrawal benefits, which is used as our DC and CB contribution.

APPENDIX B: SUPPLEMENTAL TABLES

PROJECTED BENEFIT VALUE AS MULTIPLE OF CURRENT SALARY

(All values are in DC-equivalent terms. Uniform contribution rate across plan types.)

ENTRY AGE 25

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
25.5	0.04	0.06	0.08	0.04	0.04	0.06	0.07	0.04
26.5	0.12	0.20	0.25	0.13	0.12	0.20	0.24	0.13
27.5	0.20	0.34	0.42	0.22	0.20	0.34	0.41	0.22
28.5	0.28	0.48	0.59	0.31	0.28	0.48	0.57	0.31
29.5	0.36	0.61	0.76	0.39	0.36	0.61	0.73	0.39
30.5	0.43	0.74	0.93	0.47	0.43	0.74	0.89	0.47
31.5	0.50	0.87	1.09	0.56	0.50	0.87	1.05	0.56
32.5	0.57	1.01	1.26	0.64	0.57	1.01	1.21	0.64
33.5	0.64	1.14	1.43	0.73	0.64	1.14	1.37	0.73
34.5	0.71	1.28	1.60	0.82	0.71	1.28	1.54	0.82
35.5	0.79	1.42	1.79	0.91	0.79	1.42	1.71	0.91
36.5	0.86	1.57	1.98	1.00	0.86	1.57	1.90	1.00
37.5	0.93	1.73	2.18	1.10	0.93	1.73	2.09	1.10
38.5	1.01	1.90	2.39	1.21	1.01	1.90	2.29	1.21
39.5	1.10	2.07	2.62	1.32	1.10	2.07	2.51	1.32
40.5	1.26	2.26	2.85	1.44	1.21	2.26	2.73	1.44
41.5	1.44	2.44	3.09	1.56	1.38	2.44	2.97	1.56
42.5	1.64	2.63	3.34	1.68	1.57	2.63	3.20	1.68
43.5	1.86	2.83	3.59	1.81	1.78	2.83	3.45	1.81
44.5	2.10	3.03	3.85	1.94	2.02	3.03	3.69	1.94
45.5	2.37	3.24	4.12	2.07	2.27	3.24	3.95	2.07
46.5	2.67	3.45	4.39	2.20	2.56	3.45	4.21	2.20
47.5	2.99	3.66	4.67	2.34	2.87	3.66	4.48	2.34
48.5	3.34	3.88	4.95	2.48	3.20	3.88	4.75	2.48
49.5	3.73	4.10	5.24	2.62	3.58	4.10	5.02	2.62
50.5	4.15	4.33	5.53	2.76	3.98	4.33	5.30	2.76
51.5	4.62	4.56	5.83	2.91	4.43	4.56	5.59	2.91
52.5	5.12	4.79	6.13	3.06	4.91	4.79	5.87	3.06
53.5	5.67	5.03	6.43	3.21	5.44	5.03	6.17	3.21
54.5	6.27	5.27	6.74	3.36	6.01	5.27	6.46	3.36
55.5	6.93	5.52	7.06	3.52	6.64	5.52	6.77	3.52
56.5	7.64	5.78	7.39	3.69	7.33	5.78	7.09	3.69
57.5	8.45	6.04	7.73	3.85	8.13	6.04	7.41	3.85

ENTRY AGE 25

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
58.5	9.31	6.30	8.07	4.02	8.95	6.30	7.74	4.02
59.5	10.18	6.57	8.41	4.19	9.77	6.57	8.06	4.19
60.5	11.06	6.84	8.77	4.36	10.60	6.84	8.41	4.36
61.5	11.95	7.11	9.17	4.54	11.43	7.11	8.79	4.54
62.5	12.90	7.38	9.57	4.71	12.32	7.38	9.17	4.71
63.5	13.86	7.65	9.98	4.88	13.19	7.65	9.57	4.88
64.5	14.80	7.91	10.40	5.05	14.06	7.91	9.97	5.05
65.5	15.36	8.18	10.83	5.22	14.55	8.18	10.39	5.22
66.5	15.44	8.45	11.27	5.39	14.58	8.45	10.81	5.39
67.5	15.50	8.71	11.73	5.56	14.60	8.71	11.24	5.56
68.5	15.56	8.99	12.22	5.74	14.62	8.99	11.72	5.74
69.5	15.72	9.36	12.86	5.97	14.72	9.36	12.33	5.97
70.5	15.81	9.75	13.54	6.22	14.76	9.75	12.99	6.22
71.5	15.80	10.14	14.25	6.47	14.71	10.14	13.67	6.47
72.5	15.73	10.54	14.99	6.72	14.60	10.54	14.38	6.72
73.5	15.62	10.94	15.76	6.98	14.44	10.94	15.12	6.98
74.5	15.48	11.34	16.56	7.24	14.25	11.34	15.88	7.24
75	15.17	11.75	17.39	7.50	13.94	11.75	16.68	7.50

ENTRY AGE 30

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
30.5	0.04	0.06	0.07	0.04	0.04	0.06	0.07	0.04
31.5	0.12	0.20	0.24	0.13	0.12	0.20	0.23	0.13
32.5	0.20	0.34	0.40	0.22	0.20	0.34	0.39	0.22
33.5	0.28	0.48	0.57	0.31	0.28	0.48	0.54	0.31
34.5	0.36	0.62	0.73	0.39	0.36	0.62	0.70	0.39
35.5	0.44	0.75	0.89	0.48	0.44	0.75	0.85	0.48
36.5	0.51	0.89	1.05	0.57	0.51	0.89	1.01	0.57
37.5	0.58	1.02	1.21	0.65	0.58	1.02	1.16	0.65
38.5	0.66	1.16	1.38	0.74	0.66	1.16	1.32	0.74
39.5	0.73	1.30	1.55	0.83	0.73	1.30	1.48	0.83
40.5	0.80	1.45	1.72	0.93	0.80	1.45	1.65	0.93
41.5	0.92	1.61	1.91	1.02	0.88	1.61	1.83	1.02
42.5	1.08	1.77	2.10	1.13	1.03	1.77	2.02	1.13
43.5	1.25	1.94	2.31	1.24	1.20	1.94	2.21	1.24
44.5	1.45	2.11	2.52	1.35	1.39	2.11	2.42	1.35
45.5	1.67	2.29	2.74	1.46	1.60	2.29	2.63	1.46
46.5	1.90	2.48	2.97	1.58	1.83	2.48	2.85	1.58
47.5	2.17	2.67	3.20	1.71	2.08	2.67	3.07	1.71
48.5	2.46	2.87	3.44	1.83	2.35	2.87	3.30	1.83
49.5	2.77	3.07	3.69	1.96	2.66	3.07	3.53	1.96
50.5	3.12	3.27	3.94	2.09	2.99	3.27	3.77	2.09
51.5	3.50	3.48	4.19	2.22	3.36	3.48	4.02	2.22
52.5	3.92	3.69	4.45	2.36	3.76	3.69	4.27	2.36
53.5	4.38	3.91	4.71	2.49	4.20	3.91	4.52	2.49
54.5	4.88	4.13	4.98	2.63	4.68	4.13	4.77	2.63
55.5	5.64	4.35	5.25	2.78	5.45	4.35	5.04	2.78
56.5	6.38	4.58	5.53	2.92	6.15	4.58	5.30	2.92
57.5	7.13	4.81	5.81	3.07	6.87	4.81	5.57	3.07
58.5	7.91	5.05	6.10	3.22	7.60	5.05	5.85	3.22
59.5	8.70	5.29	6.39	3.38	8.35	5.29	6.13	3.38
60.5	9.51	5.54	6.71	3.53	9.11	5.54	6.43	3.53
61.5	10.32	5.79	7.50	3.69	9.87	5.79	7.19	3.69
62.5	11.20	6.04	7.87	3.86	10.69	6.04	7.55	3.86
63.5	12.07	6.29	8.25	4.02	11.50	6.29	7.91	4.02
64.5	12.95	6.55	8.64	4.18	12.30	6.55	8.29	4.18
65.5	13.48	6.80	9.04	4.34	12.77	6.80	8.67	4.34
66.5	13.60	7.05	9.45	4.50	12.85	7.05	9.06	4.50
67.5	13.70	7.30	9.87	4.66	12.90	7.30	9.46	4.66

ENTRY AGE 30

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
68.5	13.77	7.55	10.30	4.82	12.93	7.55	9.87	4.82
69.5	13.81	7.79	10.74	4.97	12.94	7.79	10.29	4.97
70.5	13.83	8.03	11.19	5.12	12.92	8.03	10.73	5.12
71.5	13.82	8.26	11.65	5.27	12.87	8.26	11.17	5.27
72.5	13.79	8.50	12.12	5.42	12.80	8.50	11.62	5.42
73.5	13.73	8.73	12.60	5.57	12.69	8.73	12.09	5.57
74.5	13.64	8.96	13.10	5.72	12.56	8.96	12.56	5.72
75	13.29	9.19	13.61	5.86	12.21	9.19	13.05	5.86

ENTRY AGE 35

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
35.5	0.04	0.06	0.08	0.04	0.04	0.06	0.07	0.04
36.5	0.12	0.20	0.26	0.13	0.12	0.20	0.25	0.13
37.5	0.20	0.34	0.43	0.22	0.20	0.34	0.42	0.22
38.5	0.28	0.48	0.61	0.31	0.28	0.48	0.58	0.31
39.5	0.36	0.62	0.78	0.40	0.36	0.62	0.75	0.40
40.5	0.44	0.76	0.96	0.48	0.44	0.76	0.92	0.48
41.5	0.54	0.90	1.13	0.57	0.52	0.90	1.09	0.57
42.5	0.68	1.04	1.32	0.66	0.65	1.04	1.26	0.66
43.5	0.82	1.18	1.50	0.76	0.79	1.18	1.44	0.76
44.5	0.99	1.33	1.69	0.85	0.95	1.33	1.62	0.85
45.5	1.18	1.48	1.88	0.95	1.13	1.48	1.81	0.95
46.5	1.39	1.64	2.09	1.05	1.34	1.64	2.00	1.05
47.5	1.63	1.81	2.30	1.15	1.56	1.81	2.21	1.15
48.5	1.89	1.98	2.52	1.26	1.82	1.98	2.42	1.26
49.5	2.18	2.16	2.75	1.38	2.09	2.16	2.64	1.38
50.5	2.50	2.34	2.99	1.49	2.40	2.34	2.87	1.49
51.5	2.85	2.53	3.23	1.61	2.74	2.53	3.10	1.61
52.5	3.24	2.71	3.47	1.73	3.11	2.71	3.33	1.73
53.5	3.66	2.91	3.72	1.86	3.51	2.91	3.57	1.86
54.5	4.13	3.10	3.97	1.98	3.96	3.10	3.81	1.98
55.5	4.63	3.30	4.23	2.11	4.44	3.30	4.06	2.11
56.5	5.19	3.50	4.49	2.24	4.98	3.50	4.31	2.24
57.5	5.82	3.71	4.76	2.37	5.61	3.71	4.57	2.37
58.5	6.51	3.92	5.03	2.50	6.26	3.92	4.83	2.50
59.5	7.21	4.14	5.30	2.64	6.92	4.14	5.09	2.64
60.5	7.93	4.36	5.59	2.78	7.60	4.36	5.37	2.78
61.5	8.67	4.58	5.90	2.92	8.29	4.58	5.67	2.92
62.5	9.46	4.80	6.23	3.07	9.03	4.80	5.98	3.07
63.5	10.26	5.03	6.56	3.21	9.77	5.03	6.30	3.21
64.5	11.07	5.26	6.90	3.36	10.51	5.26	6.63	3.36
65.5	11.58	5.50	7.26	3.51	10.97	5.50	6.97	3.51
66.5	11.75	5.73	7.63	3.66	11.10	5.73	7.33	3.66
67.5	11.89	5.97	8.01	3.81	11.19	5.97	7.69	3.81
68.5	12.00	6.20	8.40	3.96	11.27	6.20	8.07	3.96
69.5	12.08	6.43	8.80	4.11	11.31	6.43	8.45	4.11
70.5	12.14	6.66	9.21	4.25	11.34	6.66	8.84	4.25
71.5	12.18	6.89	9.63	4.40	11.34	6.89	9.25	4.40

ENTRY AGE 35

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
72.5	12.19	7.12	10.06	4.54	11.31	7.12	9.66	4.54
73.5	12.17	7.34	10.51	4.69	11.25	7.34	10.09	4.69
74.5	12.12	7.56	10.96	4.83	11.16	7.56	10.52	4.83
75	11.83	7.79	11.42	4.97	10.87	7.79	10.97	4.97

ENTRY AGE 40

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
40.5	0.04	0.06	0.08	0.04	0.04	0.06	0.08	0.04
41.5	0.12	0.20	0.26	0.13	0.12	0.20	0.25	0.13
42.5	0.20	0.35	0.44	0.22	0.20	0.35	0.42	0.22
43.5	0.28	0.48	0.62	0.31	0.28	0.48	0.59	0.31
44.5	0.36	0.62	0.79	0.40	0.36	0.62	0.76	0.40
45.5	0.61	0.76	0.97	0.49	0.58	0.76	0.94	0.49
46.5	0.77	0.90	1.16	0.58	0.74	0.90	1.11	0.58
47.5	0.96	1.05	1.34	0.67	0.92	1.05	1.29	0.67
48.5	1.17	1.19	1.53	0.76	1.12	1.19	1.47	0.76
49.5	1.40	1.34	1.72	0.85	1.34	1.34	1.65	0.85
50.5	1.67	1.49	1.91	0.95	1.60	1.49	1.84	0.95
51.5	1.96	1.65	2.12	1.05	1.88	1.65	2.03	1.05
52.5	2.29	1.82	2.33	1.16	2.20	1.82	2.24	1.16
53.5	2.66	1.99	2.56	1.27	2.55	1.99	2.46	1.27
54.5	3.06	2.17	2.79	1.39	2.94	2.17	2.68	1.39
55.5	3.50	2.35	3.02	1.50	3.36	2.35	2.90	1.50
56.5	3.98	2.54	3.26	1.62	3.82	2.54	3.13	1.62
57.5	4.53	2.73	3.51	1.74	4.36	2.73	3.37	1.74
58.5	5.13	2.93	3.76	1.87	4.93	2.93	3.61	1.87
59.5	5.75	3.13	4.02	2.00	5.52	3.13	3.86	2.00
60.5	6.39	3.33	4.29	2.13	6.12	3.33	4.12	2.13
61.5	7.04	3.54	4.58	2.26	6.73	3.54	4.39	2.26
62.5	7.75	3.75	4.87	2.39	7.40	3.75	4.68	2.39
63.5	8.48	3.97	5.18	2.53	8.07	3.97	4.97	2.53
64.5	9.21	4.18	5.50	2.67	8.74	4.18	5.28	2.67
65.5	9.70	4.40	5.82	2.81	9.18	4.40	5.59	2.81
66.5	9.89	4.62	6.15	2.95	9.34	4.62	5.91	2.95
67.5	10.06	4.84	6.50	3.09	9.47	4.84	6.24	3.09
68.5	10.21	5.06	6.85	3.23	9.59	5.06	6.58	3.23
69.5	10.34	5.28	7.21	3.37	9.68	5.28	6.93	3.37
70.5	10.44	5.50	7.59	3.51	9.75	5.50	7.29	3.51
71.5	10.52	5.71	7.98	3.65	9.80	5.71	7.66	3.65
72.5	10.58	5.93	8.37	3.79	9.82	5.93	8.04	3.79
73.5	10.60	6.15	8.78	3.93	9.80	6.15	8.43	3.93
74.5	10.60	6.37	9.20	4.06	9.76	6.37	8.83	4.06
75	10.52	6.58	9.63	4.20	9.67	6.58	9.25	4.20

ENTRY AGE 45

	FEMALE				MALE			
Age	DB	DC	CB	DC-EE	DB	DC	CB	DC-EE
45.5	0.04	0.06	0.08	0.04	0.04	0.06	0.08	0.04
46.5	0.12	0.20	0.26	0.13	0.12	0.20	0.25	0.13
47.5	0.20	0.34	0.44	0.22	0.20	0.34	0.43	0.22
48.5	0.28	0.48	0.62	0.31	0.28	0.48	0.60	0.31
49.5	0.36	0.62	0.80	0.40	0.36	0.62	0.77	0.40
50.5	0.86	0.76	0.98	0.49	0.82	0.76	0.94	0.49
51.5	1.09	0.90	1.16	0.58	1.04	0.90	1.11	0.58
52.5	1.35	1.04	1.34	0.67	1.29	1.04	1.29	0.67
53.5	1.64	1.19	1.53	0.76	1.57	1.19	1.47	0.76
54.5	1.97	1.34	1.72	0.85	1.89	1.34	1.65	0.85
55.5	2.33	1.49	1.92	0.95	2.23	1.49	1.84	0.95
56.5	2.74	1.65	2.12	1.05	2.63	1.65	2.04	1.05
57.5	3.21	1.82	2.34	1.16	3.09	1.82	2.24	1.16
58.5	3.71	1.99	2.55	1.27	3.57	1.99	2.45	1.27
59.5	4.25	2.16	2.78	1.38	4.07	2.16	2.67	1.38
60.5	4.80	2.34	3.01	1.49	4.60	2.34	2.89	1.49
61.5	5.38	2.52	3.26	1.61	5.14	2.52	3.13	1.61
62.5	6.00	2.71	3.51	1.73	5.73	2.71	3.37	1.73
63.5	6.64	2.89	3.77	1.85	6.33	2.89	3.62	1.85
64.5	7.30	3.08	4.04	1.97	6.93	3.08	3.88	1.97
65.5	7.77	3.28	4.32	2.09	7.36	3.28	4.15	2.09
66.5	8.00	3.47	4.61	2.22	7.56	3.47	4.43	2.22
67.5	8.21	3.67	4.91	2.34	7.74	3.67	4.71	2.34
68.5	8.41	3.87	5.22	2.47	7.90	3.87	5.01	2.47
69.5	8.58	4.07	5.53	2.60	8.03	4.07	5.31	2.60
70.5	8.72	4.26	5.86	2.72	8.14	4.26	5.63	2.72
71.5	8.84	4.46	6.20	2.85	8.23	4.46	5.95	2.85
72.5	8.94	4.66	6.54	2.97	8.29	4.66	6.28	2.97
73.5	9.01	4.86	6.89	3.10	8.33	4.86	6.62	3.10
74.5	9.06	5.06	7.26	3.23	8.34	5.06	6.97	3.23
75	9.03	5.26	7.63	3.36	8.30	5.26	7.33	3.36

Note: *DB and CB benefit values are in DC-equivalent terms. Actual DB and CB plan balances per participant are lower than stated here because DB and DC plans have higher investment returns and/or higher interest rate on annuities than DC plans. The same DC balance buys higher private insurance annuity income for men (who make up fewer than 3 out of 10 CalSTRS members) than for women because of the former's shorter life expectancy. In contrast, DB and CB plan annuities treat men and women the same. Thus DB and CB plans convert into lower DC-equivalent values for men compared to women, even though they offer the annual same retirement income for both sexes. See Methdology in Appendix for further detail.*

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