

Teacher Pensions vs. 401(k)s in Six States: Connecticut, Colorado, Georgia, Kentucky, Missouri, and Texas



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Executive Summary

Most public school teachers are covered by traditional pensions that encourage and reward long service. In this study, we determine whether most teachers working in classrooms today can expect to work long enough in the same state to accrue higher benefits under their existing traditional pension, which provides monthly income based on age and service, than they would under a 401(k)-type savings plan of equal cost. We focus on public school teachers in six states: Colorado, Connecticut, Georgia, Kentucky, Missouri, and Texas. As a point of comparison with non-teacher public employees, we also analyze Colorado state employees who are covered by the same pension plan as teachers.

Recent studies from the Urban Institute, Bellwether Education Partners, and other organizations have questioned the adequacy and fairness of defined benefit pensions for teachers, arguing that high attrition rates among new-hire teachers lead to few teachers receiving a meaningful benefit.¹ However, these studies are largely based on hypothetical new teacher cohorts, and are not representative of the teaching profession as a whole.

This study evaluates pensions against hypothetical 401(k) plans, taking into account the teaching workforce as a whole and comparing benefits across plan types on an apples-to-apples basis. For each of the six states in the study, we first analyzed teacher turnover patterns and projected the final tenure—years of service at retirement or separation—for the current teaching workforce, using retirement system actuarial assumptions. Then, for every possible combination of age and service at exit, we compared benefits under the existing teacher pension (using the least generous pension benefit tier, where applicable) and a hypothetical 401(k) with the same contribution rate as the pension. Crucially, our analysis was weighted to reflect the real-life teaching workforce in each state.

We find that traditional pensions are significantly better matched to the typical teacher’s career than 401(k) savings plans in the states in our study. Two out of three teachers (65%) will have worked at least 20 years by the time they leave service. A large majority (77%) of the educators currently serving in Colorado, Connecticut, Georgia, Kentucky, Missouri, and Texas can expect to collect pension benefits that are greater in value than what they could receive under an idealized 401(k)-type plan with no investment mistakes. **Ultimately, switching to a 401(k)-type retirement benefit would sharply reduce the retirement income security of teachers who account for a large majority of educational labor.**

Key Findings

1. Most classroom teaching is performed by long-career teachers who are well positioned to benefit from a traditional pension.

- Teacher turnover patterns reflect the powerful role of pensions in retaining experienced teachers. Attrition is high in the first few years after hire, but falls off sharply and stays low through mid-career. Attrition spikes at the specific retirement ages of each pension system.
- Teachers in the six states studied will typically serve 25 years in the same state, and leave service at age 58.

- Two out of three teachers (65%) will teach for at least 20 years in the same state.
- One out of ten teachers will leave before vesting, and nearly seven out of ten will stay until at least early retirement age. The remaining two out of ten teachers will vest, but leave before retirement age.

Exhibit 1 Projected Teacher Age and Service Years at Exit

Teacher Pension Plans	Median Service Years	Median Age	% with 20+ Service Years
Colorado	17	57	43%
Connecticut	28	60	76%
Georgia	23	57	59%
Kentucky	26	54	63%
Missouri	27	55	73%
Texas	26	62	67%
6-State Average	25	58	65%

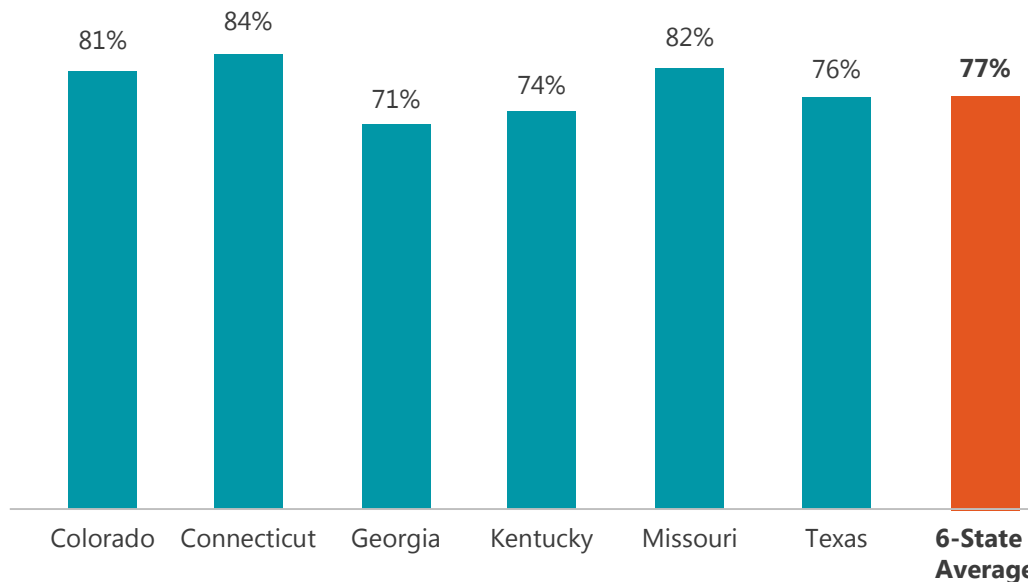
Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state averages are weighted by teacher membership count.

2. For eight out of ten teachers in the six states analyzed in this study, existing pensions—which have a wide variety of benefit provisions—provide greater, more secure retirement income compared to an idealized 401(k) savings plan.

- 77% of teachers in the six states will work long enough in the same retirement system to earn benefits of greater value and security from the lowest-tier pension, compared to an idealized 401(k) with low fees and no investment mistakes.
- The share of teachers who are better off with their pension than an idealized 401(k) ranges from 71% in Georgia to 84% in Connecticut (**Exhibit 2**). Colorado PERA, which offers greater portability of benefits than other systems, offers superior benefits than a 401(k) for 81% of teachers, despite shorter projected careers than in other states.
- Compared to a slightly more realistic 401(k) with typical individual investor behavior, the lowest-tier pension provides greater benefits to 81% of teachers in the six states.

Exhibit 2

Share of Teachers Who Are Better Off with Pension than Idealized 401(k)



Note: Analysis assumes 401(k) investment in a typical Target Date Fund, and conversion to a life annuity at retirement.

3. Conversely, only two out of ten teachers in the six states will accrue less benefit under the lowest-tier pension offered by their state, compared to an idealized 401(k)-style plan.

- Across the six states in our study, 23% of teachers will not accumulate enough service in the same retirement system to earn pension benefits from the lowest-tier pension that are greater than benefits from an idealized 401(k). Only 19% are better off with a realistic 401(k) than with a pension.
- This includes 10% of all teachers in the six states who will leave before vesting and 13% who will vest, but leave well before retirement eligibility.

4. Pensions provide significantly more valuable benefits than 401(k)s for typical teachers in all six states. Thus, most teachers would require substantially higher contributions to realize the same retirement income in a 401(k) as the lowest-tier pension.

- For the 68% of teachers who reach early retirement age, pension benefits will significantly exceed idealized 401(k) benefits. For example, early retirement pension benefits for a teacher with the median hire age are worth twice as much as an idealized 401(k) in Colorado, Kentucky, Missouri, and Texas. In Connecticut and Georgia, early retirement pension benefits are worth 50% and 30% more, respectively, than an idealized 401(k).

- Conversely, it would cost significantly more to fund 401(k) benefits that match the value of the pension earned by the typical teacher in each of the six states (**Exhibit 3**).
 - Based on a conservative modeling for a typical teacher with the median age at hire and median projected service, it would cost 20% more to fund a 401(k)-type plan to equal a typical Georgia teacher’s pension benefit. For those in Colorado, Connecticut, and Kentucky, it would cost roughly 40% more. For those in Missouri and Texas, it would cost twice as much. Differences between states reflect variation in career patterns and pension benefit provisions.
 - Based on a full-career teacher—hired at age 25 who works 30 years in the classroom—providing the same level of retirement income through a 401(k) account would cost roughly twice as much in Colorado, Kentucky, Missouri, and Texas; and about 60% more in Connecticut and Georgia.
- The main reason why it would cost more to fund a typical teacher’s retirement through a 401(k) is that a pooled pension is simply more efficient than individual investment accounts as a means of financing retirement for a large, multi-generational workforce—as a multitude of studies have shown.

Exhibit 3
Additional Contributions Required to Fund 401(k) to Achieve Same Benefit as Existing Pension

State	Typical Teacher (median entry age, median projected service)	Full-Career Teacher (entry age 25, 30 years service)
Colorado	40%	100%
Connecticut	46%	57%
Georgia	20%	65%
Kentucky	39%	103%
Missouri	98%	82%
Texas	116%	116%

Note: Authors’ analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. Idealized 401(k) assumes investment in a typical Target Date Fund, no investment mistakes, and 0.25% annual fee.

5. Comparing state employees in Colorado with teachers in Colorado and other states, we find that pensions are more valuable than 401(k)s for most employees.

- Colorado state employees are covered by the same pension benefit tier as most school employees in the state. But Colorado state employees tend to be somewhat older than school employees, and their attrition rates are higher in late career. Teachers, in turn, are hired younger and work longer than non-teacher school employees.
- Due to demographic factors including turnover and average life expectancy, the pension cost for Colorado state employees—and thus the contribution rate for the comparison 401(k)—is slightly lower than for school employees for the same benefit provisions.
- Because cost differences between teacher and state employee pensions offset the impact of different turnover rates, an equal share of Colorado state employees and school employees—81%—are better off with a pension than an idealized 401(k).

6. Implications for teacher retirement benefit policy

- As teacher shortages worsen, policymakers should understand that pensions exert a clear retention effect on teachers. Retaining experienced teachers lowers teacher turnover, eases schools' staffing pressures, and contributes to education quality.
- Shifting from pensions to 401(k)s or other account-based plans significantly reduces the retirement incomes of long-term teachers who conduct most classroom teaching and is likely to increase turnover among experienced teachers.
- While potentially benefiting short-service teachers, shifting to 401(k)s will decrease the pre-retirement and/or decrease the post-retirement income of teachers. This is because teachers will have to reduce their current consumer spending if they save more funds from their pay to preserve their level of retirement income and/or reduce their future consumer spending when they retire in the state with lower benefits.
- States concerned about equity between short- and long-term teachers should consider restoring or augmenting portability provisions in existing pensions. Such provisions include service credit purchases, pension system reciprocity, employer match on employee contribution refunds, and giving all employees the option to use their contributions to purchase lifetime income. Colorado PERA stands out as a system that provides attractive benefits to teachers and other public servants regardless of tenure.

Introduction

Most public school teachers in the US are covered by traditional defined benefit (DB) pensions that provide guaranteed monthly retirement income based on salary and years of service. For many teachers, these DB pensions provide the only significant source of guaranteed retirement income because about 40% are not covered by Social Security. Pensions also help compensate for lower pay in public school teaching compared to the private sector, controlling for education and experience.² And because traditional pension benefits are designed to encourage and reward long service, they help schools retain experienced teachers, and allow older teachers to retire with sufficient income when they are ready to retire, as their productivity begins to decline.

Over the last few years, the national debate on teacher compensation and retirement benefits has intensified, with the passage of pension benefit changes in several states, and teacher strikes in Oklahoma, Kentucky, Arizona, and West Virginia. Some states, like Colorado and Minnesota, have adjusted their existing pension benefit structure. Other states have restructured benefits, like Michigan, which now enrolls new teachers by default in a hybrid plan that combines a 401(k)-style account with a less generous pension. In early 2018, amidst a national wave of teacher strikes in red states protesting low pay, Kentucky teachers walked out when the legislature gutted a sewer bill and turned it into a pension bill that would place newly hired teachers into a hybrid plan. The Kentucky Supreme Court eventually struck down this bill on constitutional grounds.³

State legislative efforts to whittle away at teacher pensions have received a boost in recent years from studies claiming that most teachers would be better off with account-based retirement plans, whether a 401k-type defined contribution (DC) plan, or a cash balance (CB) plan. (See sidebar on p. 10 for an explanation of plan types.) These studies claim that because of high early career attrition and geographically mobility, “most teachers” will not serve under any single retirement system long enough to accrue significant benefits. However, their findings are based on a method that focuses on new-hire teachers, and ignores the career patterns of most teachers serving in public schools, who tend to be committed to a single state for most of their careers and thus stand to benefit from a traditional pension. As demonstrated in the tenure and benefit study focused on California teachers by the UC Berkeley Center for Labor Research and Education (CLRE), most classrooms are led by teachers who will work in the state at least through early retirement age.⁴ Based on the latest retirement system actuarial assumptions, 85% of California teachers are better off with the least generous pension tier under the California State Teachers’ Retirement System (CalSTRS) than with an idealized 401(k) with the same cost and no investment mistakes.⁵

As policymakers continue to debate pension policy, it is important to understand how existing pension designs affect teacher retirement security and how retirement incomes would be affected by switching to a 401(k)-type plan. Given the national wave of teacher shortages, policymakers—along with parents, school administrators, and other stakeholders—should also consider the potential impact of such a change on teacher recruitment and retention.⁶

In this study, we ask whether or not most teachers—and indeed, public employees in general—will work long enough to accrue higher benefits under their existing traditional pension than under alternative retirement plans with the same cost, i.e., expected contribution rate. Building on the

methodology developed in previous studies of California teachers by Rhee and Forna,⁷ we analyze workforce tenure patterns in tandem with pension benefits for public school teachers in six states: Colorado⁸, Connecticut, Georgia, Kentucky, Missouri, and Texas.

These systems represent a mix of small and large, Republican- and Democratic-leaning states across regions (excluding the West Coast). With the exception of some teachers in Texas and Georgia, most of the teachers in these states are not covered by Social Security, and pensions are their only source of guaranteed retirement income.⁹ We sought to obtain data from a geographically diverse array of statewide teacher retirement systems. We prioritized including retirement systems that were able to provide teacher-only data because, while most teacher pension plans include non-instructional school employees, teachers tend to be hired younger and work longer careers. The six states represent a range of benefit structures within the traditional pension framework in terms of benefit multipliers, retirement age, vesting periods, the degree to which benefits are back-loaded, COLAs, and level of portability.

In order to address whether other kinds of public employees, who typically have higher turnover rates than teachers, derive the same kinds of benefits from a traditional DB plan, we also analyzed the tenure patterns and pension benefits of state employees in Colorado.

Despite variation in benefit structure and workforce turnover, we find that a large majority of teachers in every state in our study are better off with traditional pensions than 401(k)s. On average, two out of three teachers (65%) will serve at least 20 years in the same state, and seven out of ten (68%) teachers will vest and stay until at least early retirement age. An average of 77% of teachers are better off with the lowest-tier pension than an idealized 401(k) with low fees and no individual investor mistakes, and 81% are better off compared to a more realistic 401(k) with more typical individual investor returns. The remainder of the Introduction summarizes the debate on teacher pensions vs. 401(k)s in the context of teacher career patterns, arguing that critical studies fail to consider the actual career profile of the teaching workforce, as opposed to hypothetical new hires.

- **Section I** highlights the age and service profiles and key benefit provisions of teacher pensions in Connecticut, Colorado, Kentucky, Georgia, Missouri, and Texas.
- **Section II** outlines the study methodology, which is designed to project teacher careers and retirement benefits at a granular level, and generate a rigorous comparison of pension and 401(k) benefits on apples-to-apples terms based on equivalent cost.
- **Section III** presents the results of our analysis of teacher tenure, i.e., the distribution of active teachers in each state by projected age and projected service at exit.
- **Section IV** applies the results of our benefit projection model to our findings on teacher tenure in order to estimate the percentage of active teachers who will stay long enough to accrue higher benefits under the lowest-tier pension compared to an idealized 401(k) and a more realistic 401(k) that accounts for individual investor behavior.
- **Section V** compares findings for Colorado non-school state employees to Colorado teachers and the six-state teacher plan average, and discusses the impact of differences

in demographic and career patterns between teachers, other school employees, and state non-school employees.

- Finally, the **Conclusion** discusses implications of our findings for teacher pension policy, arguing that both teachers and public education are better served by pensions than 401(k)-type plans, and that efforts to improve equity between short- and long-term teachers should focus on enhancement of pension portability rather than a wholesale switch to account-based plans.

RETIREMENT PLAN TYPES

Traditional Defined Benefit (DB) pensions, also known as Final Average Salary (FAS) DB pensions, guarantee lifetime retirement income to eligible employees. The employer is ultimately responsible for ensuring that contributions—which are managed in a pooled trust and invested by professionals—are sufficient to pay promised benefits. The amount of the monthly pension check is based on the final (or highest) average salary, years worked, and a percentage factor. For instance, for every year worked, a teacher might receive 2% of their highest average salary, such that someone retiring with 30 years of service and a final salary of \$5,000 a month will receive \$3,000 ($0.02 \times 30 \text{ years} \times \$5,000$) each month. Employees must work for a minimum number of years in order to “vest” or become entitled to monthly benefits at retirement age. Employees who leave before vesting are refunded the employee share of pension contributions plus interest. The value of DB pension benefits accrued in a given year are most valuable when an employee reaches retirement age.

Defined Contribution (DC) plans, such as 401(k)s, are individual savings and investment accounts. The employer and/or employee contributes to accounts held in the employee’s name, and the employee is ultimately responsible for managing their own investments and generating retirement income from their account. Individual employees

bear the investment risk, as well as longevity risk (the risk of running out of money if they live longer than expected). Employees immediately vest into their own contributions, and it may take several years to fully vest into the employer share of contributions. Annual contributions made early in an employee’s career are more valuable than those made in late career, because investment returns compound over time.

Cash Balance (CB) plans are a type of hybrid retirement plan. Like in a traditional DB plan, the employer is ultimately responsible for funding promised benefits, and investments are managed in a pooled trust. However, the benefits take the form of a lump sum account balance, rather than fixed retirement income. Specifically, CB plans credit each employee with a set percentage of each year’s pay, plus a minimum interest rate. This interest rate is often tied to Treasuries or similar low-risk investments, because employers who choose CB plans instead of DB pensions almost always do so as a way to offload some risk. Some CB plans share excess investment earnings with employees. CB plans and 401(k)s have a similar benefit accrual pattern in theory, but in the real world, 401(k) account balances are far more volatile. Like in a DC plan, benefits accrued in early career are generally more valuable than those accrued in mid- or late-career.

The Debate on Teacher Pensions vs 401(k)s

A series of studies have been released in recent years that argue that “most teachers” do not receive meaningful pension benefits.¹⁰ These studies cite turnover and job mobility as the basis for claiming, as Aldeman and Johnson baldly assert in an Urban Institute study, “most teachers either won’t qualify for a pension at all, or will qualify for one so meager that it will be worth less than their own contributions.”¹¹ These studies conclude that account-based retirement plans—whether a 401(k)-type defined contribution (DC) plan or a cash balance plan—would deliver greater, more equitable benefits to teachers with a typical career pattern.

We highlight two major flaws in the argument that teachers are better off with 401(k)s or other account-based plans. First, the above-mentioned studies erroneously generalize the high attrition rates that characterize new-hire teachers to the teaching profession as a whole. For instance, McGee and Winters assert in a Manhattan Institute study that only 28% of public school teachers remain in the profession for 20 years.¹² These studies then point to the fact that traditional DB pension benefits are “backloaded”—that is, the growth in the value of pension benefits accelerates in late career—and conclude that few teachers will ever collect a meaningful pension. For example, Johnson and Southgate claim in an Urban Institute report, “Relatively few California public school teachers remain employed long enough to benefit much from their retirement plan.”¹³

However, as Morrissey points out, these studies give “equal weight to anyone who ever tried teaching, however briefly. This is equivalent to saying that most gymnasts are not able to do a cartwheel based on counting every child who enrolls in a gymnastics class rather than surveying gymnasts actually practicing in gyms.”¹⁴ The claim that “most teachers” do not work long enough to benefit from a traditional pension rests on analyses that are skewed in representing new entrants, rather than a cross-section of the teaching population. This omission is problematic because the teaching profession is characterized by high attrition among new entrants and low turnover among those who choose to stay in the profession. This results in long average service among teachers serving in public schools today.

Nationally, a cursory analysis of teacher retirement system demographic data reveals that the average teacher working in public schools today already has roughly ten years of in-state service under their belt—and their actuarial experience studies show that very few teachers with that level of experience will leave the state before retirement age.¹⁵ In California, contrary to Johnson and Southgate’s claim that few teachers will reach 20 years of service, detailed analyses of CalSTRS by Rhee and Forna, weighted to reflect the state’s public school teaching workforce, found that three out of four teachers will serve at least 20 years, and nearly half will serve 30 years.¹⁶

The second major flaw in studies critical of DB pensions is that they categorize teachers who receive less than the equivalent of the plan’s normal cost compounded with the plan’s expected return, e.g., 7% or 7.5%, to be “pension losers” who are therefore better off with an account-based plan with fixed employer contributions. This is either implied, or—in the case of a 2016 study by Costrell and McGee—explicitly stated.¹⁷ This is asserted without taking into account the value of key guarantees and efficiencies in DB pensions or likely outcomes from account-based plans, and by assuming unrealistic rates of return on alternative plans.

In reality, DB pensions, which pool key risks across a large population, over generations, provide a higher return on retirement contributions than DC plans like 401(k)s, resulting in higher average retirement income.¹⁸ There are several features that lead to significant advantages for DB plans: professional, institutional-grade investment management; longer investment horizon; longevity risk pooling; and low expenses. These factors contribute to pensions earning significantly higher investment returns than individuals can realize in 401(k) accounts, and higher retirement income yield for the same retirement contributions.¹⁹ Even without fully accounting for all over these advantages, Rhee and Forna found that 84% of teachers covered by CalSTRS are better off with a pension than a hypothetical 401(k) with low fees, no investment mistakes, and an attractively priced private insurance annuity for converting account balances to lifetime income.

In summary, in order to evaluate how well teachers are served by DB pensions compared to alternative plans, it is not enough to know the percentage of new entrants who work past a given benefit threshold, or that some teachers earn a greater relative share of benefits than others based on age and years of service. It is critical to know the share of teaching positions occupied by those who serve long enough to earn higher benefits under their existing pension than they would under rigorously modeled alternative plans. This approach provides a significantly more accurate indicator of how well an existing pension serves the teaching profession as a whole, compared to studies that focus exclusively on new hire cohorts.

II. Retirement System Profiles

The pension systems analyzed in this study represent a range of geographic regions, age and experience profiles, and a diversity of benefit structures within the traditional pension framework. In selecting teacher pension systems for analysis, we prioritized statewide coverage, geographic diversity, and the ability to provide granular, preferably teacher-specific active membership data.

Membership Type

Public school teachers are covered by three types of pension plans in terms of membership composition: teacher-only plans, school employee plans, and general employee plans that include both school and non-school public employees. Teacher-only plans often include instructional staff in public schools, higher education, county departments of education, and vocational training programs, but K-12 teachers usually make up well over 80% of active membership. In school employee plans that cover both instructional and non-instructional staff, K-12 teachers represent 40–60% of active membership. Where teachers are covered by general employee pension plans, they usually make up a smaller percentage of active membership.

In order to draw meaningful conclusions about teacher career patterns, we analyzed teacher-only plans and school employee plans for the teacher pension portion of this study. **Table 1** profiles the membership base of the seven retirement plans considered in this study. Connecticut TRS, Kentucky TRS, and Missouri PSRS are essentially teacher-only plans, so their active membership data and actuarial assumptions closely represent K-12 teachers. Colorado PERA/School Division, Georgia TRS, and Texas TRS are school employee plans. For Texas, we were able to obtain active membership data for teachers and librarians—who make up 38% of the total membership—but the actuarial assumptions are for the system as a whole. While teachers make up roughly 40% of Colorado PERA/School Division and 60% of Georgia TRS, we were forced to rely on membership data and actuarial assumptions reflecting school employees in general, rather than teachers specifically. (To evaluate benefits for non-teachers, we also analyzed Colorado PERA/State Division, which covers state employees. The results are in **Appendix A**.)

Importantly, plans that cover non-teacher school employees or state employees have higher turnover rates than teacher-only plans. Thus our estimates of teacher tenure—and the share of teachers who are better off with a pension than a 401(k)—are understated for Texas, Colorado, and Georgia due to the data constraints described above.

Current Age and Service

Table 2 summarizes the age and service distribution of each retirement system. The estimated median entry age (age at hire) among active members ranges from 27 to 35. However, for plans where teacher-only membership data was available—Connecticut, Kentucky, Missouri, and Texas—the estimated median entry age ranged from 27 to 28. The older median entry age of Georgia (31) and Colorado PERA School Division (35) probably reflects the older age profile of non-teachers who make up a significant share of members in these plans.

Table 1
Retirement System Profile

	Membership Base	Active Membership, FY 2017
Colorado PERA – State Division	State employees	54,814 excl. troopers
Colorado PERA – School Division	K-12 teachers and other public school employees	122,990 ~40% teachers
Connecticut TRS	K-12 teachers and college faculty	50,877
Georgia TRS	School employees and college faculty	222,902 ~60% teachers
Kentucky TRS	K-12 teachers	71,108
Missouri PSRS	K-12 teachers	78,274
Texas TRS	Teachers and other school employees	864,233 38% teachers & librarians

Table 2
Current Active Membership Age and Service Profile, FY 2017

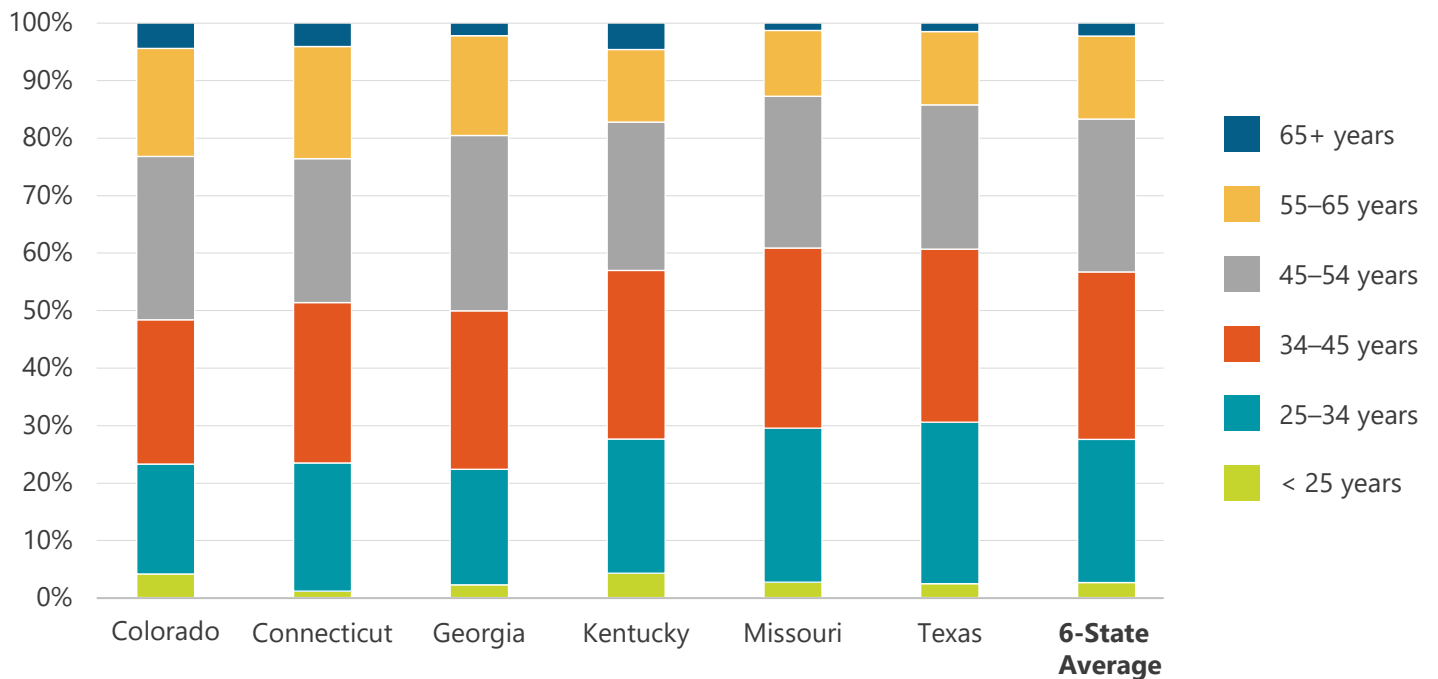
	Median Estimated Entry Age	Median Age in 2017	Median Service Years in 2017	% with <5 Service Years
Colorado PERA – State Division	36	46	6	29%
Colorado PERA – School Division	35	45	6	46%
Connecticut TRS	28	44	12	20%
Georgia TRS	31	45	10	31%
Kentucky TRS	28	42	8	36%
Missouri PSRS	27	41	10	25%
Texas TRS	28	41	10	27%

The typical teacher in all six states is in their 40s, consistent with national teacher statistics and mirroring the age profile of the college-educated labor force.²⁰ The median number of service years ranges from 6 to 12, with Texas, Missouri, Connecticut, and Georgia close to estimated national median of 11 years of total teaching experience. Connecticut has both an older and more experienced teaching workforce compared to other teacher-only systems. The age and service profile of Colorado PERA State Division is typical for state employee plans, in which older professional workers, many with advanced degrees, are overrepresented relative to the private sector.²¹

Table 2 also shows the share of active membership with less than five years of service, which ranges from 20% in Connecticut to 46% in Colorado PERA School Division. The share of recently hired public sector employees fluctuates significantly with economic cycles, dropping during budget deficits and rising during economic recoveries. Thus the above statistics represent an annual snapshot as of the 2017 fiscal year in each state.

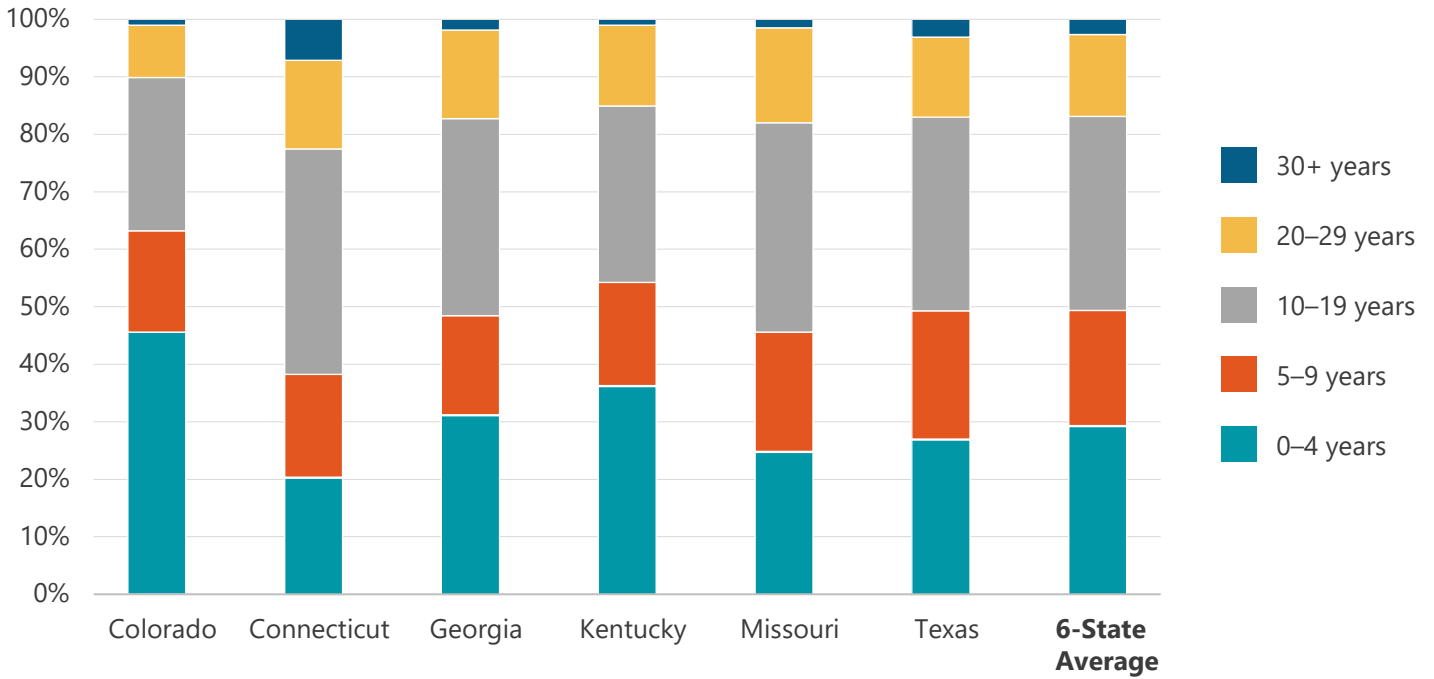
Figure 1 and **Figure 2** illustrate the current age and service distributions of teachers in each state in greater detail. The overall age mix of teachers is relatively consistent across the six states. Most of the variation between states is accounted for by the share of recently hired teachers—those with less than five years of service—which in turn is a reflection of differences in new-hire turnover rates.

Figure 1
Distribution of Teachers by Current Age



Note: Authors' analysis of retirement system active membership data as of FY 2017. Six-state averages are weighted by teacher membership count.

Figure 2
Distribution of Teachers by Current Service Years



Note: Authors' analysis of retirement system active membership data as of FY 2017. Six-state averages are weighted by teacher membership count.

Benefit Structure

Table 3 summarizes the service retirement benefit provisions for the lowest benefit tier in each plan, applicable to current new hires. Key components include:

- **Vesting period** – the number of service years required for retirement benefit eligibility.
- **Normal retirement age (NRA)** – the age at which vested members become eligible for unreduced service retirement benefits, i.e., monthly retirement income for life based on their salary and years of service.
- **Benefit multiplier at NRA** – the percentage of salary replaced for each service year at normal retirement age. For instance, a teacher who has vested may receive 2% of their highest average salary for each year of service. With 30 years of service, they receive 60% of their highest average monthly salary as their pension check.
- **Additional NRA thresholds** – some plans allow normal retirement benefits at earlier ages for teachers who were hired at younger ages and have worked a full career (e.g., any age with 30 years of service in Missouri).
- **Cost-of-living-adjustments (COLAs)** – some plans guarantee COLAs to ensure that pension payments do not fall significantly behind the cost of living over time. Guaranteed COLAs are a significant component of pension benefit cost and value.

Another key plan feature is treatment of early retirement. Many plans allow for retirement before NRA, subject to a wide array of age and service rules. The benefit multiplier is reduced to compensate for the increased number of years that benefits will be paid. Some plans have more generous early retirement formulas than others, but early retirement benefit formulas generally do not financially penalize early retirees. Early retirement provisions are significant because the more favorable they are, the greater the value of the pension compared to 401(k) plans in which individuals face steep tradeoffs between retirement age and the amount of lifetime monthly retirement income.

Retirement systems also set different interest rates on employee contribution account accumulations—which are paid to employees who leave before vesting, and to employees who vest but choose to cash out rather than receive a lifetime annuity at retirement. (Early retirement rules, member account interest rates, and other benefit provisions can be found in **Appendix B.**)

Plans vary in the level of backloading and portability. “Backloading” refers to the fact that under a typical DB pension, the longer an employee works in the same retirement system, the faster the growth in retirement benefits in relation to pay. This is a key design feature in traditional DB pensions, meant to retain experienced employees for the long term. “Portability” refers to features that work in the opposite direction, enhancing the value of benefits for employees who do not stay attached to one employer or retirement system for a long time. Such features include allowing teachers to purchase service credits, reciprocity agreements between retirement systems, and money purchase benefits that ensure that employees receive an adequate return on their employee contributions (where the service retirement benefit might be lower). It is important to note that in statewide retirement systems, pension benefits are portable across a large number of participating employers.

Two systems, Georgia and Colorado, offer “money purchase” benefits that allow members to convert their employee contributions plus interest into lifetime retirement income at favorable interest rates. Money purchase benefits increase portability, to the extent that they ensure a reasonable return on employee contributions.

We highlight key features of each system below.

Colorado Public Employees’ Retirement Association (Colorado PERA)

PERA has unusually portable benefits for a traditional pension. Any employee who leaves before retirement age, whether or not they have accrued five years of service, can keep their contributions in PERA. The contributions accrue 3% interest annually, and the account balance can be withdrawn at any time, including a 50% match for vested members. At retirement eligibility, they can convert their account balance—plus a match of 100% for vested members—into a “money purchase” retirement annuity at 7.25% interest (compared to a 5% or less projected interest rate generally available in private insurance annuity markets). Members who are also eligible for both a service retirement benefit and a money purchase benefit receive the greater benefit of the two. Normal retirement benefits are capped at 100% of highest average salary. COLAs are not guaranteed, and are awarded on basis from a separate fund based on investment performance and fund size, with an annual maximum of 1.5%.

Table 3
Summary of Service Retirement Benefits - Lowest Benefit Tier in Effect in 2018

	Vesting Period (years)	Benefit Multiplier @ NRA (% of salary replaced for each service year)	Normal Retirement Age (NRA)	Other NRA Thresholds	Benefit @ NRA with 30 service years	Guaranteed COLA?
Colorado PERA	5	2.5%	65	Age 60 with 30 svce years, or any age with 35 svce years	$30 \times 2.5\% = 75\%$ of Highest Average Salary	No
Connecticut TRS	10	2% (20+ svce years) prorated 1-1.9% (10-19 years)	60	2% @ any age with 35 svce years	$30 \times 2\% = 60\%$	Yes
Georgia TRS	10	2.0%	60	None	$30 \times 2\% = 60\%$	Yes
Kentucky TRS	5	1.7% if ≤ 10 svce years 2% > 10 and ≤ 20 2.3% > 20 and ≤ 26 2.5% > 26 and ≤ 30 3% for each svce year > 30	65	Any age with 27 svce years	$30 \times 2.5\% = 75\%$	Yes
Missouri PSRS	5	2.5%	60	Any age with 30 svce years, or when age + svce ≥ 80 (Rule of 80)	$30 \times 2.5\% = 75\%$	Yes
Texas TRS	5	2.3%	65	Age 62 with 30 svce years; age 62 with Rule of 80	$30 \times 2.3\% = 69\%$	No

Note: Plan provisions from retirement system CAFRs and Actuarial Valuations for FY 2017. Missouri PSRS and Connecticut TRS only have one tier. Colorado PERA School Division members with 10 or more years of service who meet the Rule of 88 are eligible for normal retirement.

Connecticut Teachers' Retirement System (Connecticut TRS)

Connecticut's plan appears to be the most backloaded among the plans in our study. Ten years of service are required to vest for service retirement benefits, and 20 years are required to receive the full 2% benefit multiplier at normal retirement age. The multiplier is prorated for those with 10 to 19 years of service, from 1% to 1.9%. However, Connecticut offers a relatively attractive interest rate on employee contributions, passing on the pension fund's returns. Normal retirement benefits are capped at 75% of salary.

Teachers Retirement System of Georgia (Georgia TRS)

Like Connecticut, Georgia also has a 10-year vesting requirement. The plan provides retirement benefits that are the greater of a) the service retirement benefit, or b) the money purchase benefit based on member contributions plus interest, converted into an annuity based on a generous 7.5% interest rate. Pensionable service is capped at 40 years, after which members can opt out of employee contributions.

Teachers' Retirement System Kentucky (Kentucky TRS)

Kentucky's benefit formula appears significantly backloaded at first glance because the multiplier progressively increases with years of service. However, unlike most DB plans, Kentucky TRS has a feature that favors younger-hire compared to older-hire teachers because the NRA is set to the earlier of age 60 or 27 years of service. Thus a teacher with 27 years of service at age 55 and a teacher with 27 years of service at age 60 with similar salaries will receive the same monthly benefit—but the former will collect this benefit for five more years, due to the earlier retirement age. A teacher who leaves at age 54 with 26 years of service can collect unreduced benefits at age 55, when they would have reached 27 years of service.

Public School Retirement System of Missouri (Missouri PSRS)

In addition to the standard NRA of 60, Missouri uses the "Rule of 80" to provide unreduced service retirement benefits to teachers whose age and accrued service years total at least 80. Thus a teacher hired at age 24 who works for 28 years can collect pension benefits based on the full 2.5% multiplier as early as age 52 (since $52 + 28 = 80$). Normal retirement benefits are capped at 100% of salary.

Teacher Retirement System of Texas (Texas TRS)

Among the six states in this study, Texas appears to have the least generous pension benefits for teachers. The standard NRA is 65 for the lowest tier, with 62 being the minimum for those who have served 30 years or meet the Rule of 80. Texas TRS does not offer a guaranteed COLA. However, the plan has relatively favorable early retirement provisions.

III. Methodology Overview

In order to understand whether defined benefit pensions or 401(k) savings plans better serve teachers and other public employees, we combined a fine-grained employee tenure projection with a rigorous pension/401(k) benefit projection that allows for comparison of benefits on apples-to-apples terms. The methodology is summarized below; a detailed explanation of assumptions and methods can be found in **Appendix B**.

Tenure analysis

First, we projected the age and service at which current retirement system active members will exit, based on 1) their current age and accrued service and 2) actuarial assumptions including rates of withdrawal, death, disability retirement, and service retirement for each retirement system. We requested and obtained a detailed age-service table for the active membership as of FY 2017 from each retirement system. We also obtained the latest actuarial assumptions, including service retirement, withdrawal, pre-retirement mortality, and disability retirement rates, contingent on age and accrued service years. We then applied these rates to each current age-service cohort (e.g., 25 years old with one year of service, 25 years old with two years of service, and so on) on a forward-looking basis until none of the currently active teachers remained in service. The result is a distribution of currently active members by age and service at exit.

Benefit analysis

We calculated pension and 401(k) benefits for each entry age between 17 and 90, at every possible age and service credit combination at exit, using the salary growth assumptions of each plan. For pension benefits, we applied the benefit policies of each plan to calculate employee contribution refunds, early retirement benefits, and normal retirement benefits, as applicable. We assumed that exiting employees chose the benefit with the greatest value. For retirement systems with more than one benefit tier, we used the most recent, least generous tier.

For 401(k) benefits, we used the “normal cost” for retirement and withdrawal benefits as the contribution rate. The normal cost of a pension is the contribution rate, expressed as a percentage of payroll, needed to fund benefits accrued by current employees in a given year—assuming that the pension fund realizes expected investment returns and other actuarial assumptions. Account balances were projected over time based on expected returns on a typical target date fund (TDF). TDFs, also known as lifecycle funds, automatically shift from risky, higher-return stocks to less risky, lower-return bonds as a worker approaches retirement, and are common investment vehicles for 401(k) plans. For the baseline idealized 401(k), we assumed low fees (0.25% a year) and no individual investor mistakes. For a somewhat more realistic 401(k), we assumed a 1% reduction in investment returns as a reasonable estimate of the impact of typical individual investor behaviors, e.g., chasing returns during bull markets (buying high) and selling off assets during downturns (selling low).²²

Pension benefits for service retirement take the form of guaranteed monthly payments, while 401(k) benefits take the form of a lump sum account value consisting of contributions and accumulated investment returns. In order to compare the two on apples-to-apples terms, we calculated the lump sum necessary to purchase a private insurance annuity equivalent to calculated pension payments,

including any guaranteed COLA, at every possible retirement age. The annuity factors used for this conversion were based on 5% interest, 5% load (as an estimate of insurance company profit and overhead), and each system's post-retirement mortality assumptions. For the realistic 401(k), we assumed a 4% interest rate, which is still higher than current private annuity rates. For each entry age/service year combination, we determined whether DB benefits exceeded the 401(k) benefit, or vice versa.

For both the pension and the 401(k), we assumed perfect funding discipline, i.e., consistent contributions and no borrowing or withdrawals for other purposes. We also assumed that underlying investments perform as expected in both plans.

Estimating the pension advantage

Finally, we applied the findings from the benefit analysis to the results of the tenure analysis to calculate the share of active members who will receive greater benefit from the pension compared to both an idealized 401(k) and a more realistic 401(k).

We do not model cash balance plans in this study. As we explained above, CB plans entail individual account benefits, expressed as a lump sum, with a minimum return guarantee backed by the employer. CB benefit projections for a given contribution rate depends entirely on assumptions about the return guarantee and plan asset allocation—in other words, the level of risk in the plan and how it is allocated between the employer and employees. In theory, the guaranteed return could be the same as traditional DB plan expected returns—e.g., 7.5% during the accumulation phase and decumulation phase. But it is unrealistic to assume that any state would enact an alternative plan that has the exact same risk profile and cost as an existing DB plan, but gives the most valuable benefits to those who leave early and sacrifices the retention incentives of a traditional pension.²³ Overall, real-world public sector CB plans are significantly less generous than prevailing DB pensions because they are used to reduce both cost and risk, resulting in significant benefit reductions. To the extent that a hypothetical CB plan guarantees low interest rates and offers supplemental investment earnings (and shoulders the investment risk needed to do so), its hypothetical benefits would be similar to the benefits projected in our 401(k) model.

IV. How Long Will Teachers Work in the Same State?

When the career trajectories of the active teaching workforce in the six states are considered, a pattern emerges that has very different implications for the evaluation of retirement benefits than one based solely on new hires. In this section, we present findings on teacher turnover patterns, the distribution of active teachers by projected service years and age at exit, and teachers' projected vesting and retirement eligibility status at exit. Overall, we find that a large majority of the teaching workforce in each of the six states in this study—Connecticut, Colorado, Georgia, Kentucky, Missouri, and Texas—is made up of educators who will work long enough to benefit from a traditional pension.

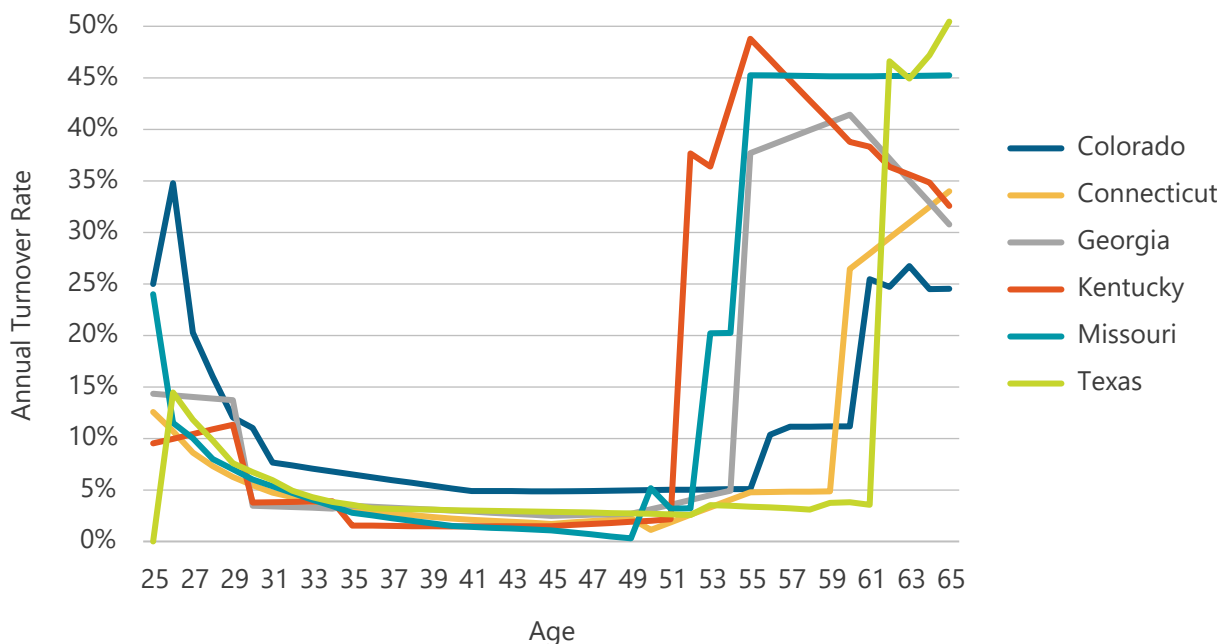
- Turnover is high in the first five years after hire, then steeply drops off until the age when teachers first become eligible for early retirement. Attrition patterns in each of the six states clearly show that teachers respond to the retention incentives built into pension benefits.
- On average, two out of three teachers (65%) will accrue at least 20 years of service, and about half of that number (31% of the total) will retire with 30 or more years.
- The typical teacher in the six states combined will serve until age 58.
- About seven out of ten teachers (68%) currently serving in public schools in the six states will work until they are eligible for service retirement under the rules of the lowest-tier pension.

The Impact of Pensions on Teacher Turnover

It is currently estimated that nationally, 17% of new hire teachers leave the profession within the first four years.²⁴ While this is a significant policy challenge for public education, it is important to understand that most classrooms are occupied by long-service teachers. That is, teaching is a vocation, characterized by high turnover among novices who are figuring out whether the career fits them, and low attrition rates among mid-career teachers.

Figure 3 illustrates turnover rates over time for a cohort of 25-year-old new hires in each retirement system. Cohort turnover is highest during the first five years, declines through mid-career, and then spikes upon retirement benefit eligibility. It is easy to see the retention effect exerted by the DB pension benefit structure. Assuming continuous full-time service, a new hire teacher who is 25 years old can receive early (reduced) retirement benefits at age 50 in Colorado, Connecticut, Georgia, and Missouri, 52 in Kentucky, and 55 in Texas. This same 25-year-old newly hired teacher is eligible for normal (unreduced) retirement benefits at age 60 in Colorado and Connecticut, 52 in Kentucky, 55 in Georgia, 53 in Missouri, and 65 in Texas.

Figure 3
Annual Turnover Rates for Teachers Hired at Age 25



Note: Authors' calculations based on actuarial assumptions from FY 2017 actuarial valuation or latest actuarial experience study. In Texas, virtually all first-year teachers accrue one full service year under TRS rules before exiting.

Most Teachers Can Expect Decades of Service in the Same State

We applied the above turnover rates—replicated for every possible entry age and exit age—to the active membership in order to project the distribution of teachers by age and service at exit.

To begin, **Table 4** shows the median projected age and median projected service at exit among teachers in each state, and in the six states combined. The median projected exit age is 58, and median projected service years is 25. Across the six states, 65% of teachers will accrue at least 20 years of service.

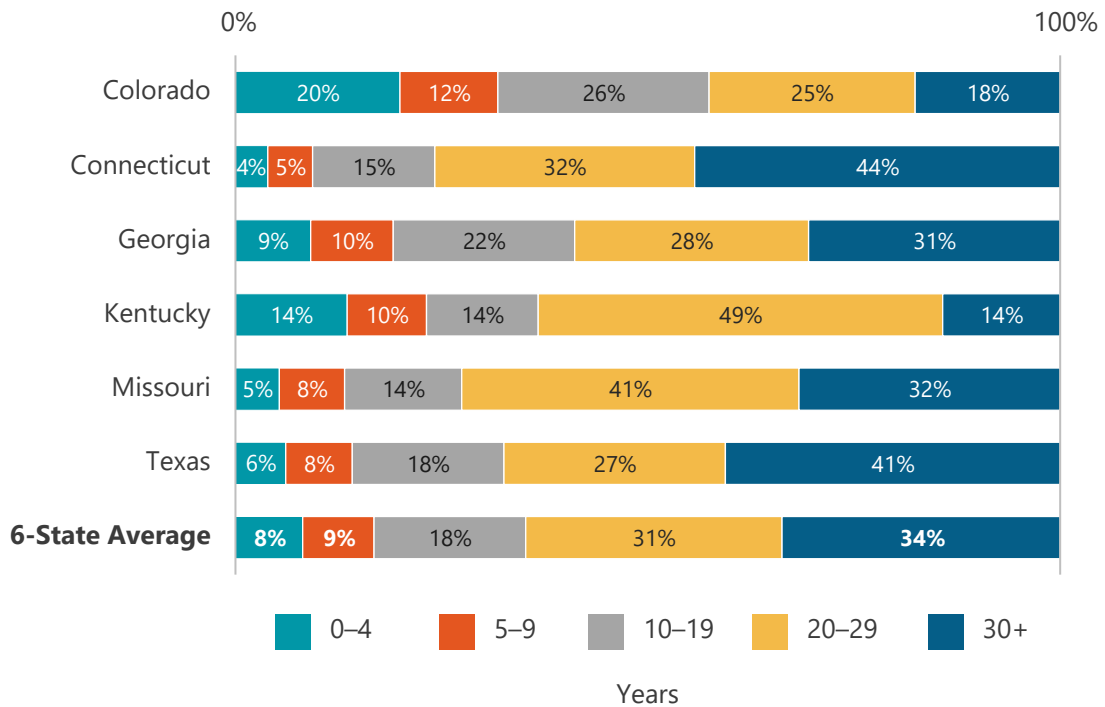
Figure 4 shows the distribution of teachers by projected total service at separation. Only 8% will leave before completing five years of service. As noted above, 65% of teachers in the six states will work at least 20 years, with 31% accumulating 20 to 29 years and 34% accruing at least 30 years of service. Among the six states, Connecticut and Texas have the highest shares of teachers who will serve at least 30 years—44% and 41%, respectively—and both have a normal retirement age of 65. Connecticut also has an older, more experienced teacher workforce than the other states. Kentucky and Colorado have the lowest estimates of teachers reaching 30 years of service, 14% and 18%, respectively. The Kentucky TRS benefit policy allows for normal retirement after 27 years of service.

Table 4
Projected Teacher Age and Service Years at Exit

Teacher Pension Plans	Median Service Years	Median Age	% with 20+ Service Years
Colorado	17	57	43%
Connecticut	28	60	76%
Georgia	23	57	59%
Kentucky	26	54	63%
Missouri	27	55	73%
Texas	26	62	67%
6-State Average	25	58	65%

Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state averages are weighted by teacher membership count.

Figure 4
Distribution of Teachers by Projected Service Years at Exit



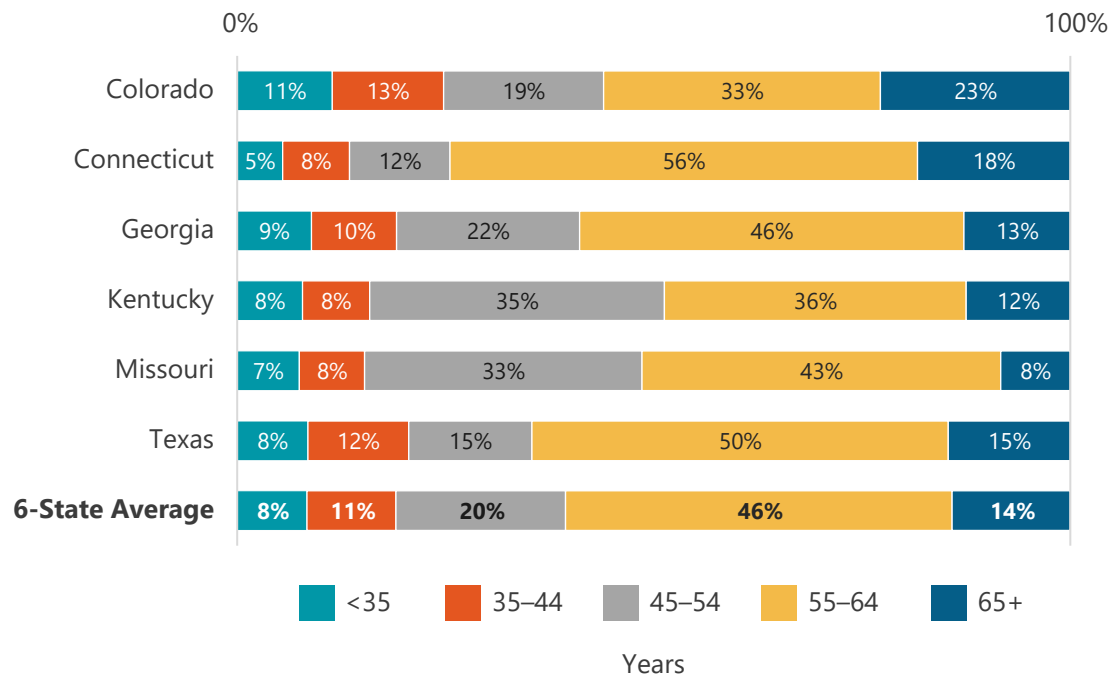
Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state averages are weighted by teacher membership count.

The low estimate of Colorado teachers reaching 30 years is due to a number of factors, including relatively portable benefits, older average age at hire, and the fact that we were only able to access membership and actuarial assumptions for all school employees combined, rather than specifically for teachers, who tend to enter earlier and serve longer than other school employees. We expect an analysis of Colorado teachers based on teacher-specific data would yield longer average projected service.

Most Teachers Will Work until Late Career in the Same State

The distribution of teachers by projected age at exit is illustrated in **Figure 5**. A majority of teachers in the six states (60%) will be at least age 55 when they leave. In Connecticut, 74% of teachers will be at least age 55 when they leave service. Kentucky and Missouri have the lowest shares of teachers working until at least age 55—48% and 51%, respectively—due to relatively generous retirement age policies. Colorado, with its older age profile, has the largest share of teachers working past age 65 (23%), compared to the six-state average of 14%, despite having the lowest median projected tenure of 17 years of service (per **Table 4**).

Figure 5
Distribution of Teachers by Projected Age at Exit



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state averages are weighted by teacher membership count.

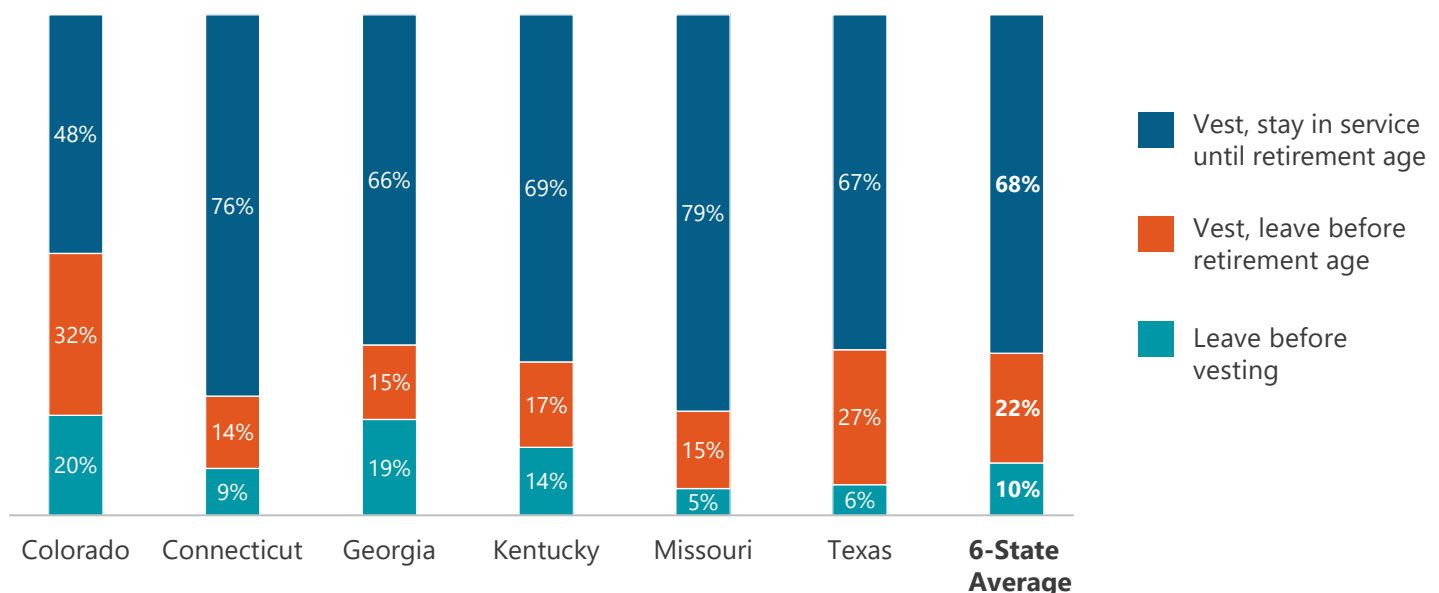
Most Teachers Will Work in the Same State until Retirement Age

In addition to projected service and age at exit in absolute terms, it is useful to understand where teachers will stand in relation to vesting and retirement eligibility rules by the time they leave service. This is because the growth in the value of traditional pension benefits accelerates a few years before teachers become eligible for immediate retirement benefits, and spikes sharply at early retirement age. As we will discuss in Section V, any teacher who reaches early retirement age will be certain to have earned benefits that significantly surpass what they could accumulated through a 401(k) with the same contribution rate.

Figure 6 illustrates the distribution of teachers by projected status at exit—those who have not vested, those who have vested but not have not reached retirement age, and those who have vested and reached retirement age. On average, 10% of current teachers in the six states will leave before vesting. Another 22% will vest, but leave before retirement age. A large majority, 68%, will vest and work until retirement age.

At the high end, 76% of teachers in Connecticut and 79% of teachers in Missouri will work until retirement age. While Connecticut has an older, more experienced teacher workforce than Missouri, the latter has more generous early retirement policies. Missouri allows early retirement at age 55 (or at any age with 25 years of service). Connecticut also allows early retirement at any age with 25 years of service, but otherwise restricts early retirement at age 55 to those with 20 years of service.

Figure 6
Distribution of Teachers by Vesting and Retirement Eligibility Status at Exit



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state averages are weighted by teacher count.

At the low end, 48% of teachers in Colorado are projected to serve until retirement age. An estimated 20% of Colorado teachers will not vest, in large part due to significantly higher new hire turnover rates compared to other states. However, as will be discussed in the benefit analysis, non-vested teachers do not fare particularly poorly in relation to a hypothetical 401(k) because of the portability of PERA benefits. Similarly, a 2016 study commissioned by the state legislature found that Colorado PERA, due to its portability, provides superior benefits compared to DC and hybrid plans for a wide variety of career paths.²⁵

In summary, a large majority of teaching positions are occupied by long-career teachers. Most teaching work is performed by full-career teachers and those who, regardless of hire age, will serve until retirement age. Only a small percentage of teaching positions are occupied by those who leave the state before accumulating substantial service, or well before retirement age. This has profound implications for the evaluation of alternative retirement benefits in relation to the teacher pensions, as we demonstrate in the next section.

V. How Do Teachers Fare under Pensions Compared to 401(k)s?

In this section, we evaluate how teachers fare under the current pension systems, compared to a hypothetical 401(k) in Connecticut, Colorado, Georgia, Kentucky, Missouri, and Texas. Building on our analysis of teacher exits in relation to vesting and retirement eligibility, we compare the value of benefits from the DB pension and hypothetical 401(k) at early retirement age for the typical teacher in each state. Next, we estimate the share of teachers who are better off in the DB pension, based on the projected exit age and service year accrual, compared to the Idealized 401(k) and the Realistic 401(k). Finally, we estimate the percentage increase in retirement plan contributions necessary to fund 401(k) benefits that would match the value of the projected pension benefit for the typical teacher in each state based on median entry age and projected service, and for a full career teacher.

As noted in the methodology overview in **Section II**, we constructed apples-to-apples comparisons for each state by converting service retirement benefits into 401(k)-equivalent values, i.e., lump sums necessary to purchase a private insurance annuity with the same benefit. This reflects our assumption that 401(k) balances are used to purchase private insurance annuities with the same COLA, if any, as the pension benefit. At the same time, our benefit projection model is arguably tilted in favor of the 401(k) plan (see methodology in **Appendix B**). In this regard, our estimates of the share of teachers who are better off with the DB pension in their state are conservative.

- For the typical teacher, pensions are worth roughly twice as much as an idealized 401(k) upon initial retirement eligibility in Colorado, Kentucky, Missouri, and Texas. In Connecticut and Georgia, where benefits are more backloaded, typical teacher pensions are still worth 30% more than an idealized 401(k) at initial retirement eligibility.
- An overwhelming majority (77%) of teachers in the six states combined are better off with the lowest-tier pension than an idealized 401(k) with the same contribution rate.
- When individual investor behavior is taken into account by reducing projected 401(k) returns by 1%, 81% of teachers are better off with the lowest-tier pension.
- In all six states, most teachers would require substantially higher contributions to realize the same retirement income in a 401(k) as the lowest-tier pension.

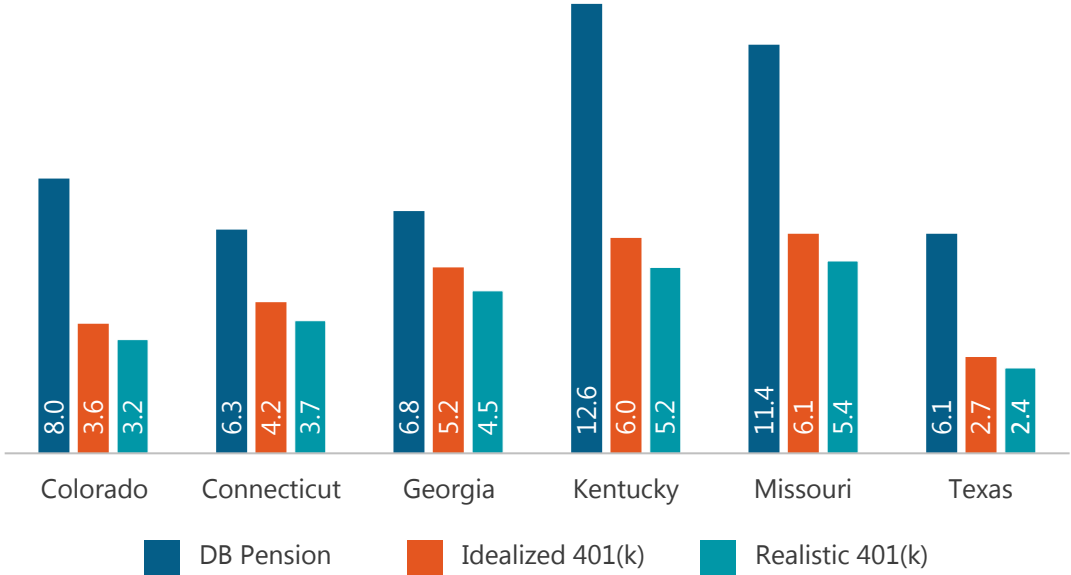
Seven out of Ten Teachers Will Work until Their Pension Is Worth Significantly More than a 401(k)

As we discussed above, 68% of teachers in the six states combined will serve until at least early retirement age. By that point, DB pension benefits will significantly exceed the value of hypothetical 401(k) benefits based on the same contribution rate. **Figure 7** shows the ratio of the value of benefits to salary for a typical teacher in each state, by plan type. We calculated benefits at the

earliest eligibility for immediate retirement benefits using the median retirement age (see **Table 2** in **Section II**). (For the DB pension, we converted the lump sum necessary to purchase the same retirement annuity as the DB pension from private insurance, assuming the same interest rate used in the Idealized 401(k). For the Idealized and Realistic 401(k)s, we used projected account values. We then divided the value of benefits for each plan by the teacher’s projected salary at that age. For the median entry age, teachers could retire after 25 years of service in Colorado, Connecticut, Georgia, and Missouri, and after 27 years of service in Kentucky and Texas.

Variation in the ratio of DB pension value across states is attributable to both the relative generosity of benefits and the age and service of the exemplar teacher. The magnitude of difference between the DB pension value and 401(k) value is mostly attributable to the degree of backloading in each plan. Thus in the four states with five-year vesting periods—Colorado, Kentucky, Missouri, and Texas—DB pensions are worth roughly twice as much as the idealized 401(k). In Connecticut and Georgia, which have 10-year vesting and somewhat more backloaded benefits related to their normal retirement age policies, the DB pension is worth 50% and 30% more, respectively, than the idealized 401(k).

Figure 7
Ratio of Benefit Value to Salary at Earliest Retirement Age for Typical Teacher



Note: Calculations are based on estimated median entry age and service retirement provisions in each state.

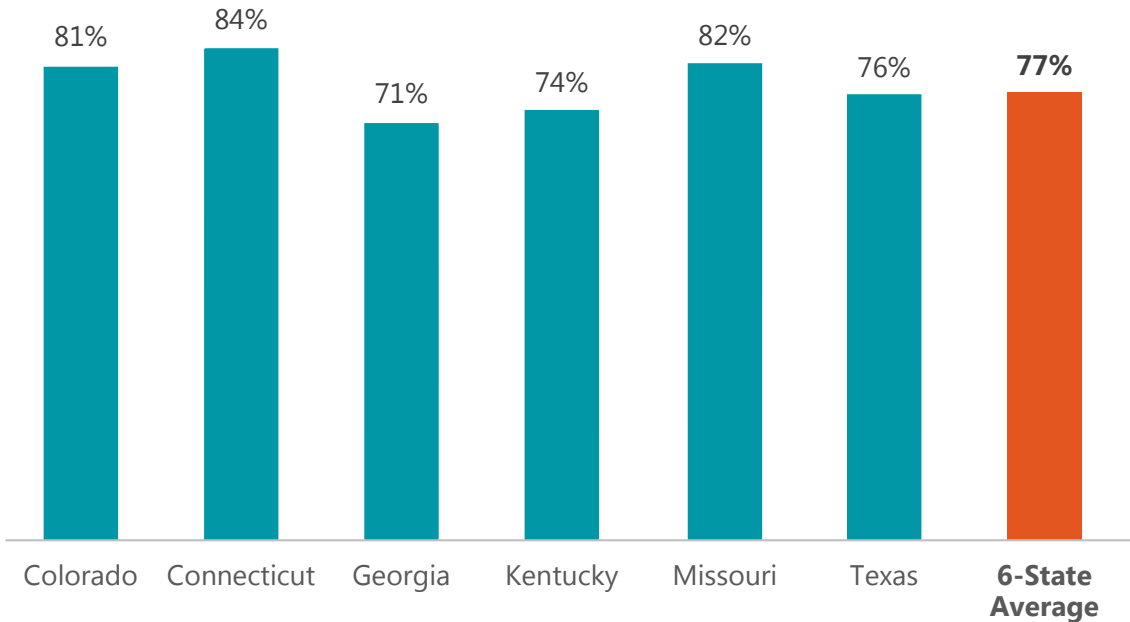
This analysis shows that the 68% of teachers who will work until service retirement eligibility are substantially better off with a DB pension compared to an idealized 401(k). But teacher pensions surpass hypothetical 401(k) benefits several years before early retirement age. In the case of Colorado PERA, the pension plan delivers superior benefits immediately upon vesting at five years, largely because of their generous matching policy on employee contribution withdrawals and money purchase benefits at retirement age.

Eight Out of Ten Teachers Will Be Better off with Their Pension than a 401(k)

Combining our benefit analysis and tenure projection model, we identified the age and service thresholds when the pension benefit equals or exceeds the value of an idealized 401(k) plan for every age-service cohort within the teacher population in each state, and calculated the share of active teachers who will serve until they meet that threshold.

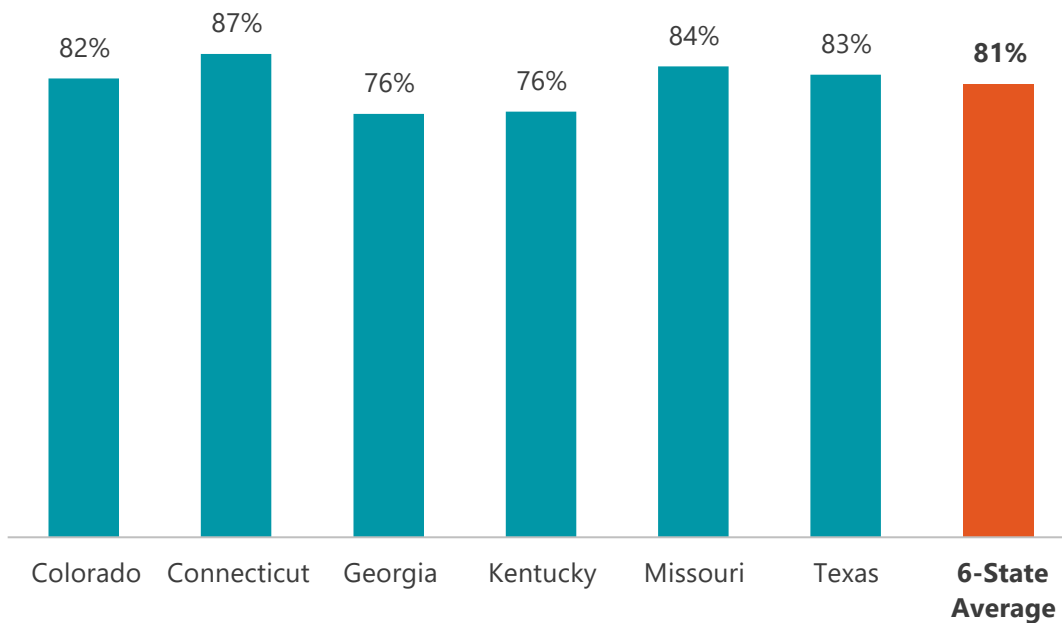
As **Figure 8** illustrates, an overwhelming majority of teachers in each of the six states will earn pension benefits that are worth more than what they could realize in an idealized 401(k) with the same contribution rate and average target date fund investment returns. The six-state teacher-weighted average is 77%, with individual states ranging from 71% (Georgia TRS) to 84% (Connecticut TRS). Colorado, which has high turnover and the lowest average teacher experience, also has the least backloaded benefit structure, leading to 81% of teachers who are better off with the Colorado PERA benefit than a 401(k). Connecticut has 10-year vesting, which seemingly would work against the pension plan, but the state also has a more experienced teacher workforce. It is difficult to definitively identify the causes of variation, because turnover and average teacher tenure are significantly, but not entirely, determined by benefit structure.

Figure 8
Share of Teachers Who Are Better Off with Pension than Idealized 401(k)



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. Idealized 401(k) assumes investment in a typical Target Date Fund, no investment mistakes, and 0.25% annual fee. 6-state average is weighted by teacher membership count.

Figure 9
Share of Teachers Who Are Better Off with Pension than Realistic 401(k)



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. Realistic 401(k) assumes typical individual investor returns. 6-state average is weighted by teacher membership count.

401(k)s Cost More for the Typical Teacher Retirement Benefit

The above analysis compares benefits for teachers from DB pensions and 401(k) plans based on the same contribution rate. It is also helpful to know how retirement contribution rates would change if we hold benefit levels steady across the two plan types.

For each state, we calculated the ratio of 401(k) benefits to pension benefits for two types of teachers: a conservatively modeled "typical" teacher, and a full-career teacher initially hired at age 25. The benefit for the "typical" teacher, based on median entry age and median service years, reflects a younger exit age than the median exit age in our analysis, and thus receives less than the median benefit. Based on these findings, we calculated the increased cost of funding 401(k) benefits that would match the value of the pension benefits that these teachers can expect to earn.

Without exception, it would cost significantly more to fund 401(k) benefits that have the same value as the pension earned by the typical teacher in each of the six states (**Table 5**). The magnitude of increased cost varies due to differences in teacher demographics and pension benefit structure. It would cost 20% more to fund a typical Georgia teacher's retirement benefit in a 401(k) than it does through the state's teacher pension plan. For those in Colorado, Connecticut, and Kentucky, it would

cost 40%, 46%, and 39% more respectively. For those in Missouri and Texas, it would cost twice as much—98% and 116%.

Providing the same level of retirement income for the full-career teacher through a 401(k) account would cost roughly twice as much in Colorado, Kentucky, and Missouri, and Texas, and about 60% more in Connecticut in Georgia. While only one-third of teachers in this study are projected to reach 30 or more service years, this model is important because teacher pension benefits are typically designed to provide retirement income adequacy—ranging from 60% to 85% of highest average salary based on 30 years of service and normal retirement age. This is especially important because most of the teachers in the six states in this study are not covered by Social Security.

Table 5
Additional Contributions Required to Fund Idealized 401(k) to Achieve Same Benefit as Existing Pension

State	Typical Teacher (median entry age, median projected service)	Full-Career Teacher (entry age 25, 30 years service)
Colorado	40%	100%
Connecticut	46%	57%
Georgia	20%	65%
Kentucky	39%	103%
Missouri	98%	82%
Texas	116%	116%

Note: Authors’ analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. Idealized 401(k) assumes investment in a typical Target Date Fund, no investment mistakes, and 0.25% annual fee.

Critically, these large cost differentials cannot be explained by the idea that short-term teachers are “paying for” the benefits of long-term teachers, as researchers critical of teacher pensions suggest.²⁶ To be sure, the backloading of traditional pensions results in significant differences in benefits between those who leave early in their career and those with average tenure. However, referring back to **Figure 6**, those who leave without vesting or before retirement age comprise only 32% of teachers—and an even smaller share of payroll, because these teachers have lower average pay than those who work longer. Thus, the difference between short-term teachers’ benefits and the average plan benefit is not large enough to account for the magnitude of the cost increase.

As we discussed in the Introduction, it simply costs much more to fund 401(k) benefits equal to pension benefits for the average teacher because pensions are inherently more cost-efficient.²⁷ A

significant contributing factor is a longer investment horizon compared to individual investment accounts, which allows for higher expected investment returns. Another is the advantage of professional investment management. This advantage is accounted for in our comparison of each pension plan with the Realistic 401(k), but excluded is in the comparison with the Idealized 401(k). Two other factors—lower administrative and investment expenses and longevity risk pooling—were taken out of the equation in this study by assuming conversion of 401(k) balances into private insurance life annuities with generous interest rates and low fees (0.25%).

In other words, even without fully accounting for the relative efficiency of a DB pension, we find that it would cost significantly more to provide the typical teacher's retirement income through a 401(k). Ultimately, switching to a 401(k) with the same expected cost translates to a significant reduction in teacher retirement income. In Texas, for example, benefits would be slashed in half for the typical teacher. Switching to a 401(k) with lower cost means an even steeper reduction in teacher retirement income.

Ultimately, what this means is that switching from a pension to a 401(k)-style plan (and to a lesser but still significant extent, a cash balance plan which has similar benefit accrual patterns) will reduce the retirement incomes of a large majority of teachers, and the typical teacher will see a significant benefit cut.

Conclusion: Lessons for Retirement Benefit Policy

Contrary to the claims made by a number of studies, an overwhelming majority (77%) of teachers working in the profession today will serve long enough to earn guaranteed pension benefits that exceed what they might have accumulated through an idealized 401(k) savings account with the same contribution rate. Conversely, most teachers would see significantly lower retirement income under a 401(k) than what they would earn through the lowest-tier pension in each of the states in this study. Because it costs significantly more to fund the same retirement benefits through a 401(k) as through a pension, a 401(k) can only cut costs through steep benefit reductions. Given that most teachers in the six states in this study are not covered by Social Security, such a shift would have grave consequences for their ability to retire with dignity after long service in public schools.

Most states currently face a teacher shortage, and many are resorting to hiring retired teachers to fill the gap.²⁸ Policymakers should understand that pensions exert a clear retention effect on experienced teachers—lowering teacher turnover, easing schools' staffing pressures, and contributing to education quality.²⁹ Conversely, shifting from pensions to 401(k)s or other account-based plans is likely to increase turnover. While some advocate for a more open, mobile labor market for teachers, it is important to understand that this would incur tremendous costs to schools in terms of recruitment and training.

Shifting to 401(k)s might benefit short-service teachers, but it will significantly reduce the retirement incomes of long-term teachers who make up a large majority of the teaching workforce in public schools. Furthermore, 401(k)s will decrease the aggregate retirement benefits paid to teachers, largely as the result of the inefficiencies of an individual account system compared to a pooled pension. This means teachers will reduce their current spending in order to make up the difference through private savings, and/or see a reduction in their future consumer spending due to lower retirement benefits. States are already concerned about the negative long-term fiscal and economic impact of retirement insecurity, and are looking for ways to improve the retirement readiness of private sector workers. From this perspective, switching to 401(k)s rather than modifying existing teacher pension plans is a step in the wrong direction.

Finally, policymakers concerned about equity in retirement benefits between short- and long-term teachers should consider restoring or augmenting portability provisions in existing pensions, such as service credit purchases, pension system reciprocity, matching employee contribution refunds, and allowing all employees regardless of vesting status to purchase lifetime income with their accumulated contributions. Some states have been moving away from portability provisions and lengthening vesting periods in an attempt to cut costs, but the savings are arguably minimal, with detrimental effects on recruitment. Colorado PERA stands out as a system that provides attractive benefits to teachers and other public servants regardless of tenure.

In conclusion, pensions provide greater retirement security to teachers in Connecticut, Colorado, Georgia, Kentucky, Missouri, and Texas—and, based on previous studies, California—than a cost-equivalent 401(k). Pensions also have a powerful impact on teacher turnover and workforce management, encouraging long service and allowing older teachers to retire with dignity. Policymakers, parents, and other stakeholders in public education should be skeptical of claims that teachers and public schools would be better off with 401(k)s and other account-based plans.

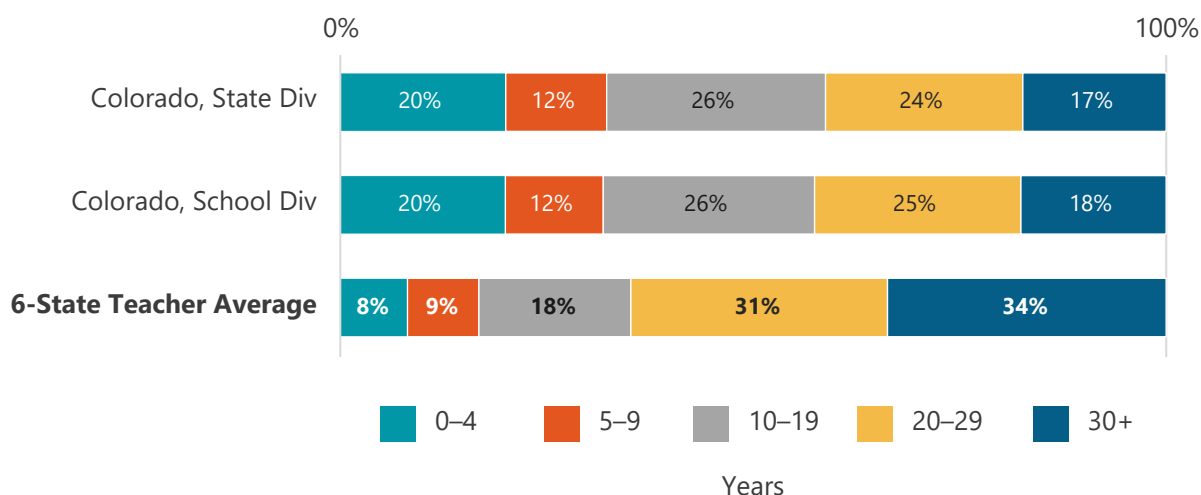
Appendix A: Colorado State Employees

Colorado state employees are covered by the same pension benefit tier as most school employees in the state. But state employees tend to be somewhat older than school employees. Among school employees, teachers are hired younger and serve longer than non-teacher school employees. When reviewing state employees and school employees in Colorado, we find virtually no difference in the share of active members who are better off with a pension than a 401(k). The slightly lower normal cost for state employees than for school employees for the same benefit tier translates to a slightly larger pension income advantage compared to a 401(k) for both median age/service and full-career members.

State Employees and School Employees in Colorado Have Similar Tenure Profiles

The median projected service at exit is 16 years for Colorado state employees, compared to 17 years for Colorado school employees and 25 for teachers across the six states. State employees have slightly higher turnover rates than school employees in Colorado, but the difference is negligible compared to the weighted average for teachers across all six states. As **Figure A.1** reveals, the projected distribution of teachers by service at exit is nearly identical for state employees and school employees. However, because the current age of state employees is somewhat older, a slightly larger share—27% compared to 23%—will leave after they reach age 65 (see **Figure A.2**). The overall shorter tenure, combined with markedly high turnover in the first five years after hire, means that 20% of members will not vest and 48% will stay until retirement age—compared to 10% and 68%, respectively, for teachers in the six states combined.

Figure A.1
Distribution of Active Members by Projected Age at Exit,
Colorado State Employees vs. School Employees and Teachers



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state average includes CO, CT, GA, KY, MO, and TX.

Figure A.2
 Distribution of Active Members by Projected Age at Exit,
 Colorado State Employees vs. School Employees and Teachers

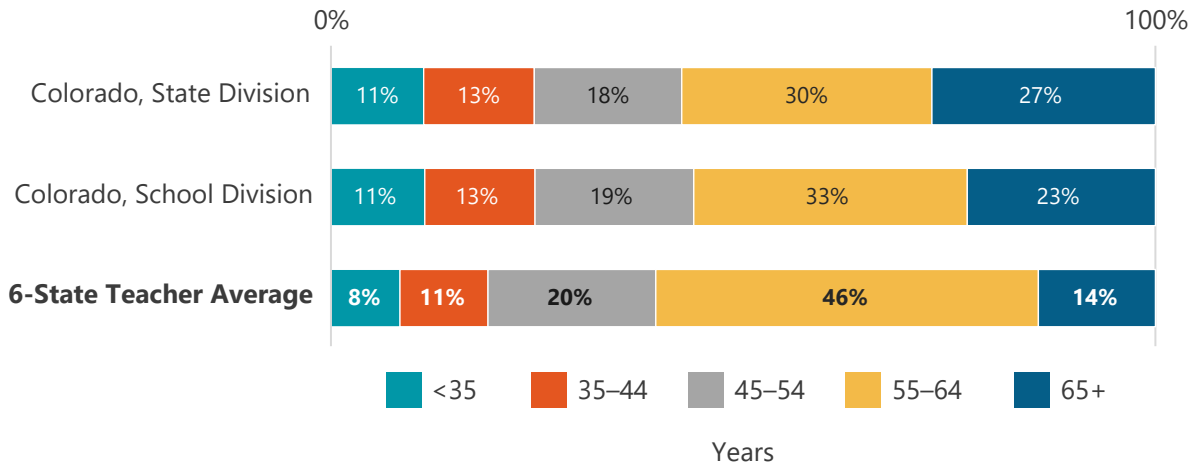
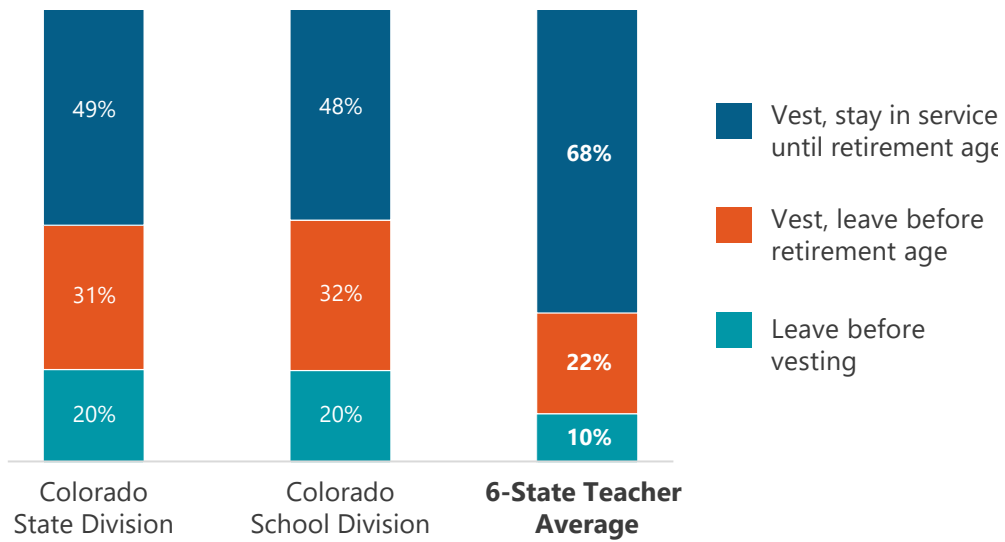


Figure A.3
 Vesting and Retirement Eligibility at Exit,
 Colorado PERA State Division vs. School Division and Teacher Average



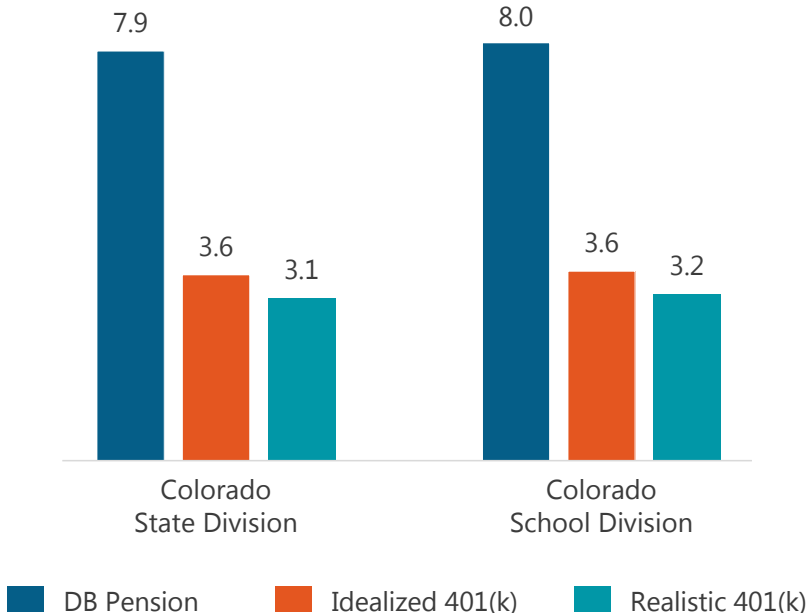
Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. 6-state teacher average includes CO, CT, GA, KY, MO, and TX.

Colorado State Employees and School Employees Benefit Equally from Their Pension

Because Colorado state employees have slightly shorter careers in the same retirement system compared to school employees, the pension cost for the state employees—and the associated hypothetical 401(k) benefit—is lower than for school employees: 9.58% versus 10.50% of pay for retirement and withdrawal benefits (see **Table B.4** in **Appendix B**). However, because salary growth is faster for school employees than for state employees, there is very little difference in the ratio of 401(k) benefits to salary for a typical employee at early retirement age (**Figure A.4**). In addition, the Colorado PERA pension is worth more than twice the hypothetical 401(k) benefit at early retirement age for both state employees and school employees.

Though not quite half of state employees will serve until retirement eligibility, it is important to note that PERA portability features create a smoother benefit accrual curve than most DB pensions. Most pensions spike dramatically in value at retirement age—along with the magnitude of difference in relation to the value of hypothetical 401(k) benefits. In contrast, the relative advantage of PERA over a hypothetical 401(k) differs little whether an employee chooses to leave at age 50, versus the early retirement age of 55. Furthermore, our benefit model indicates that PERA benefits exceed a hypothetical 401(k) in value immediately upon vesting at five years.

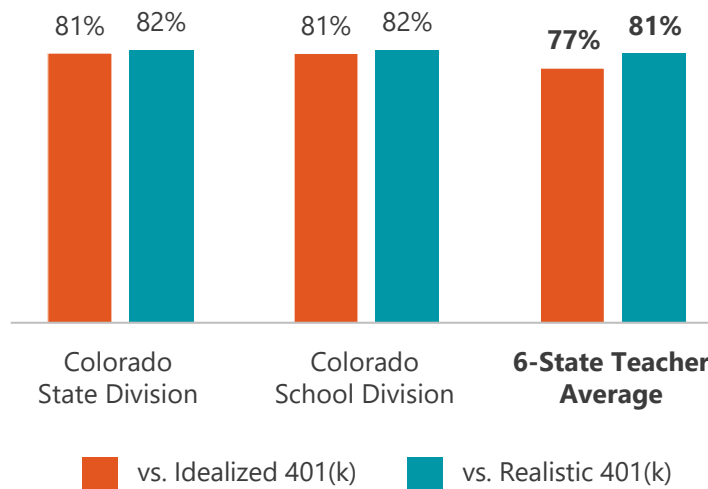
Figure A.4
 Ratio of Benefit Value to Salary at Earliest Retirement Age for Typical Employee, Colorado State and School Employees



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. Idealized 401(k) assumes investment in a typical Target Date Fund, no investment mistakes, and 0.25% annual fee. Realistic 401(k) assumes typical individual investor returns. 6-state teacher average includes CO, CT, GA, KY, MO, and TX.

Ultimately, an equal share of Colorado state employees and school employees—81%—are better off with a pension than an idealized 401(k) (**Figure A.5**). Despite significantly higher than average turnover, the portability of Colorado PERA benefits leads to the pension providing a clearly better value for a larger share of members, compared to the six-state teacher average. It would cost 45% more to fund an idealized 401(k) account to match the value of PERA benefits for a Colorado state employee with typical entry age and service, and 94% more for a full-career employee (**Table A.1**).

Figure A.5
Share of Members Who are Better Off with Pension than 401(k), Colorado State and School Employees



Note: Authors' analysis based on retirement system active membership data and actuarial assumptions as of FY 2017. Idealized 401(k) assumes investment in a typical Target Date Fund, no investment mistakes, and 0.25% annual fee. Realistic 401(k) assumes typical individual investor returns. 6-state teacher average includes CO, CT, GA, KY, MO, and TX.

Table A.1
Additional Contributions Required to Fund Idealized 401(k) to Achieve Same Benefit as Colorado PERA

State	Typical Employee (median entry age, median projected service)	Full-Career Employee (entry age 25, 30 years service)
Colorado, State Division	45%	94%
Colorado, School Division	40%	100%

Finally, Colorado PERA stands out as a retirement system that offers the best of a traditional pension—a focus on adequate retirement income and pooled risk—and also leverages the efficiency of a pooled pension to deliver attractive benefits to employees regardless of tenure. To recap, any member is eligible for lifetime retirement income at retirement eligibility based on their employee contribution account balance, through the money purchase benefit. Vested members can opt for a refund of member contributions plus interest with a 50% match before retirement age. At retirement age, vested members are eligible for a 100% match on their employee contribution account. They can elect to withdraw the entire amount, or receive the greater of the money purchase benefit based on their employee contribution account (plus match) at an attractive interest rate, or the service retirement benefit.

Appendix B: Detailed Methodology

In order to understand how teachers and other public employees are affected by the benefits they will receive under existing pension benefits compared to a hypothetical 401(k) plan, we developed a tenure projection model and a benefit projection model. The tenure projection model uses retirement system actuarial assumptions and current active membership data to yield a distribution of exits by age and service year. The benefit projection model estimates the retirement benefit for each possible entry age under the existing DB pension and a hypothetical 401(k). Modeling approaches and key assumptions are outlined below.

Tenure Projections

We first calculated total annual attrition rates—i.e., exit probabilities—for each age, at each year of service, based on each retirement system’s assumptions regarding withdrawal, retirement, disability, and pre-retirement mortality. Where we were not able to obtain detailed rates from the retirement system or actuarial experience studies, we interpolated annual rates from sample rates published in the latest actuarial valuation or experience study.

Critically, we also obtained detailed active membership age-service tables from each system. For most states—Georgia, Connecticut, Missouri, and Kentucky—data was obtained for the system’s entire active membership base. Texas TRS provided a custom data file consisting only of teachers and librarians, who make up less than half of the overall membership. (However, the TRS actuarial assumptions are for the plan as a whole.) We obtained a custom tabulation for Colorado PERA State Division members excluding state troopers, and Colorado PERA School Division members.

We applied age- and service-specific exit probabilities to the active membership based on their current age and years of service, in successive yearly iterations until none of the current active teachers remained in service. We projected 60 years’ worth of iterations in order to allow the youngest members in the sample time to reach the age when 100% retirement is assumed, typically age 75. We excluded cohorts whose age and service credit data indicated they had been hired prior to age 17. These made up less than 100 members in the six states combined, so their exclusion had no material impact on the model results. This modeling process generated the distribution of exit counts by age and service for active employees.

Benefit Modeling

In order to compare existing DB pension plans to a hypothetical 401(k) plan, it is necessary to analyze them in apples-to-apples terms. DB plans are “defined” in terms of benefits provided. For example, the annual retirement benefit earned for a year of service might be 2% of average pay. DC plans are “defined” in terms of the contribution made to a plan each year, and the benefit takes the form of an accumulated savings account value consisting of contributions and investment returns. We first calculated the DB pension benefits for each system, then calculated the 401(k) account balance required to purchase the same retirement income stream through a private insurance group annuity. We then calculated 401(k) savings account accumulations assuming contributions equal to the normal cost for the DB system retirement and withdrawal benefits, plus investment returns from a typical target date fund (TDF).

General Projection Model Approach

Our analysis projected DB pension and 401(k) benefits for every possible entry age/exit age/exit service permutation. For DB pensions, we modeled the lowest-tier benefit for each retirement system for each possible “entry age” (which roughly corresponds to age at hire).³⁰ For each entry age, benefits were calculated for each possible year of service at exit—including member contribution account refunds, deferred retirement benefits (if not eligible for immediate retirement), immediate retirement benefits, and any money purchase benefits. Money purchase benefits consist of the conversion of the member contribution account balance into a life annuity using the retirement system’s expected return as the interest rate.

In addition to each retirement system’s benefit policy, we use their assumptions for increases in salary to project benefits.

For 401(k) benefits, the accounts were assumed to grow at investment return rates that vary by age based on a typical TDF asset allocation glidepath. Gross returns were decreased by 0.25% for administrative expenses for the Idealized 401(k), and by an additional 1% for the Realistic 401(k) to account for typical investor behavior. Early withdrawals and loans were not considered. The annual 401(k) contributions were assumed to equal the normal cost rate of the retirement benefits and withdrawal benefits provided by each retirement system, multiplied by projected salary.

DB Annual Benefit Amounts

Pension systems provide retirement benefits under a fixed formula contingent on age and years of service (see **Table B.1**). Our analysis applied the retirement formula to participants at each possible entry age. For vested members projected to exit after retirement eligibility, we calculate the benefits they would receive if they start collecting retirement benefits immediately. For vested members who terminate before retirement eligibility, we assumed they claimed their pension at the earliest possible date. We tested the model for sensitivity to different retirement timing decisions from early retirement age up until normal retirement age, given the same age and service at exit. The resulting benefit value changes were minor, and did not shift the break-even points between the DB pension and 401(k) savings plan.

For systems with money purchase benefits—Colorado PERA and Georgia TRS—we estimated the annual money purchase annuity payments resulting from the conversion of member account balances into an annuity based on retirement system mortality rates and assumed rate of investment return. Colorado PERA money purchase benefits are based on PERA-wide average mortality rates—rather than the mortality rates specific to each division—and this is reflected in our calculations.

DB Refunds and Lump-Sum Cashouts

Our model estimated refunds of employee contributions (plus interest and employer match, where applicable) according to each plan’s benefit policy (see **Table B.2**). Our model did not analyze optional lump-sum cashouts, which are calculated on actuarial terms in lieu of monthly retirement benefits. While some members might have good reason to choose this option (for instance, if they are terminally ill), lump sum cashouts are often less valuable than lifetime pension benefits when considered in DC-equivalent terms. This is because the private market often provides lower individual investment returns during the retirement draw-down phase than are available to DB plans.

Table B.1
Pension Service Retirement Provisions Used in Benefit Model

		Colorado PERA	Connecticut TRS	Georgia TRS	Kentucky TRS	Missouri PSRS	Texas TRS
Retirement Age Policy	Service requirement for vesting	5 years	10 years	10 years	5 years	5 years	5 years
	Normal retirement eligibility after vesting	Age 65 or 35 years of service; Rule of 88 with 10 years of service in School Div.	Age 60 or 35 years of service*	Age 60 or 30 years of service	Age 60 or age when member would have attained 27 years of service	Age 60, age when member would have attained 30 years of service, or Rule of 80	Age 65
	Early retirement eligibility	Age 60, age 55 with 20 years of service, or age 50 with 25 years of service	Age 55 with 20 years of service; any age with 25 years of service	Any age with 25 years of service	Age 55 with 10 years of service	Age 55; or any age with 25 years of service	Age 55; any age with 30 years of service; or Rule of 80
Retirement Benefit Formula	Benefit multiplier at normal retirement age	2.5%	2.0% for members with 20+ years of service; .1% deducted for each year less than 20 years.	2.0%	Ranges from 1.7% at 5 years to 3.0% for 30+ years. (See Table 1 in Section II for details.)	2.5%	2.3%
	Benefit cap	100% of HAS	75% of HAS	40 years of service; employee contribution optional thereafter		100% of HAS	
	Highest Average Salary (HAS) base for retirement benefit calculation	Highest 3 years	Highest 3 years	Highest 2 years	Highest 5 years	Highest 3 years	Highest 5 years
	Cost-of-living-adjustment (COLA) assumption	None (COLA paid out of separate fund and is not guaranteed)	1.75%	1.50%	1.50%	1.65%	None

* Connecticut TRS distinguishes between retirement with 20 years of service at age 60 (Normal Retirement) and retirement with 10-19 years at age 60 (Pro-rated Retirement), but we group both as normal retirement in this table. In addition, Connecticut teachers can apply up to 5 years of service credit from other pension systems to meet normal and early retirement eligibility requirements, but we only estimate Connecticut service in this study.

Note: Data from retirement system CAFRs and actuarial valuations for FY 2017. Benefit provisions reflect the lowest tier applicable to employees hired in 2018.

Table B.2
Withdrawal Benefits

	Colorado PERA	Connecticut TRS	Georgia TRS	Kentucky TRS	Missouri PSRS	Texas TRS
Interest rate on employee contributions	3.0% current policy	8.0% assumed	4.5% current policy	2.5% assumed	1.0% assumed	2.0% current policy
Termination benefit—not yet vested	Refund of employee contributions plus interest; or keep in account and continue to accrue interest. Account value at age 65 can be converted into a life annuity at 7.25% interest (assumed return)	Refund of 6% contributions plus interest	Refund of employee contributions plus interest	Refund of employee contributions plus interest	Refund of employee contributions plus interest	Refund of employee contributions plus interest
Termination benefit—vested, employee contribution refund	Refund of employee contributions plus interest, with 50% employer match on account balance	Refund of 6% contributions plus interest, and additional 1% contributions without interest	Refund of employee contributions plus interest	Refund of employee contributions plus interest	Refund of employee contributions plus interest	Refund of employee contributions plus interest
Other benefits for vested members eligible for retirement	Members can elect a refund of employee contributions and interest with a 100% match on account balance; or convert that amount into a life annuity (money purchase); or claim the service retirement benefit		Members receive the greater of service retirement benefit or money purchase benefit based on employee contributions and interest			

Note: Data from retirement system CAFRs and actuarial valuations for FY 2017.

DB Values (401(k)-equivalent)

In order to facilitate comparison between the DB pensions and 401(k) plans, we converted DB annuity benefits—whether service retirement benefits or money purchase annuities—into 401(k)-equivalent cash values. In other words, we estimated the 401(k) balance necessary to purchase the income stream provided by the DB retirement system through a private insurance annuity, assuming 5% interest with 5% load for insurance company profits and expenses and retirement-system specific mortality tables. For teacher-only systems, which are over 75% female, we used female post-retirement mortality rates to price annuities. For Colorado PERA, because the state division is slightly over half male, we calculated blended (sex-weighted) rates as well as female-specific rates for both the State Division and School Division. We ran a sensitivity analysis using the female-specific and blended rates, and found that it made a trivial difference in the findings. We therefore used female annuity rates for all plans. Where employees separated prior to retirement eligibility, we factored in 401(k) investment growth between separation and retirement. For instance, if \$100,000 was the amount necessary to purchase a given DB pension income stream, and the 401(k) account was expected to yield 25% cumulative investment returns between separation and retirement, we calculated the DB pension value as $\$100,000 / 1.25$, or \$80,000.

401(k) Account Values

Account balances under a 401(k) plan were estimated each year by crediting the anticipated investment return based on a TDF asset allocation glidepath, and annual contributions equal to the normal cost of retirement and withdrawal benefits in the DB plan (See **Table B.3** for contribution rates).

We excluded the normal cost of death benefits and disability retirement benefits, which are typically 0.5% of payroll. In effect, we treated these death and disability benefits as a separate insurance program. Excluding a DB pension plan's normal cost for death and disability benefits from the DC plan contribution rate is conservative because private insurance companies would typically charge more than the pension plan for these benefits.

Actuarial Assumptions

Investment Return Assumptions

Gross investment returns for the 401(k) plan were based on a hypothetical TDF based on the age of the member. The TDF asset allocation glidepath reflects a composite of Vanguard and Fidelity target date fund series. For each age in the glidepath, we calculated the geometric mean return from capital market assumptions obtained from Milliman for our previous studies of CalSTRS, consisting of arithmetic mean returns, volatility, and correlations between asset classes. Geometric mean returns are lower than arithmetic returns because they account for “volatility drag,” i.e., the negative impact of market volatility on the cumulative investment returns. Using arithmetic mean returns to calculate 401(k) balances over an individual's career without accounting for the impact of market volatility would result in unrealistically high balances. For example, the arithmetic mean return for the TDF is 8.64% at age 25 and 7.14% at age 60, compared to the geometric mean return of 7.30% at age 25 and 6.49% at age 60.

Table B.3
Plan Contribution Rates

	Colorado PERA	Connecticut TRS	Georgia TRS	Kentucky TRS	Missouri PSRS	Texas TRS
Total normal cost for benefit tier	10.82% School; 10.10% State	10.60%	13.77%	14.84%	17.02%	10.06%
Estimated normal cost for retirement and withdrawal benefits and administrative costs (used as DC contribution rate)	10.5% School; 9.58% State	10.11%	13.27%	14.34%	16.356%*	9.56%
Employee contribution rate (used to calculate member contribution account refunds and money purchase benefits)	Escalates from 8% to FY 2017 to 10.00 in FY 2022.	7.00%	6.00%	9.105%	14.50%	7.70%

*MO retirement & termination benefit normal cost excludes the 1% load for service credit purchases built into the base normal cost.

Note: Data from retirement system CAFRs and actuarial valuations for FY 2017. Normal cost estimates for retirement and withdrawal benefits (exclusive of death and disability benefit cost) were provided by retirement system staff. When not available, we deducted an average estimate of .5% of payroll for death and disability.

In order to streamline benefit modeling, we used a uniform set of TDF investment return assumptions for all six states. The baseline TDF model's underlying inflation assumption is 2.75%, with a gross return of 7.3% at age 25 based on approximately 90% equities and 10% fixed income. See **Table B.4** for sample investment returns by age.

Table B.4
Baseline Target Date Fund Investment Returns

Age	Gross Return	Age	Gross Return
25	7.30%	60	6.49%
30	7.30%	65	6.15%
35	7.29%	70	5.67%
40	7.24%	75	5.38%
45	7.15%	80	5.09%
50	6.96%	85	4.81%
55	6.72%	90	4.52%

Note: Underlying inflation assumption is 2.75%. Table reflects geometric mean returns that account for volatility drag. Underlying arithmetic mean return for age 25 is 8.6%.

Net investment return rates were assumed to be the gross rates shown above minus 25 basis points (0.25%) to reflect efficient 401(k) investment and account maintenance expenses for the Idealized 401(k). For the Realistic 401(k), we reduced annual returns by another 1.0% to account for the drag on returns from typical individual investor behavior. The fact that individual investors tend to underperform institutional investors, even after controlling for asset allocation, is well supported by empirical data and behavioral finance research, and 1% is a conservative estimate of the resulting drag on returns.³¹

We took pension fund expected returns as given. In most cases, they had no bearing on our retirement benefit calculations. (See **Table B.5**.) However, these returns factored into our estimates of money purchase benefits, where applicable. In accordance with plan provisions, we used the nominal investment return as the interest rate for Connecticut TRS member contribution accounts.

Public pension discount rates, which are used to determine the funding required to meet benefit obligations, are generally equal to the expected long-term average rate of return on pension plan investments. Discount rate determination is a complex process informed by plan demographics, actuarial experience, investment policy, and risk tolerance, among other factors. On average, pension plans have generally met or exceeded their investment return targets over the long term.

Table B.5
Retirement System Expected Returns

	Colorado PERA	Connecticut TRS	Georgia TRS	Kentucky TRS	Missouri PSRS	Texas TRS
Nominal investment return	7.25%	8.00%	7.50%	7.50%	7.60%	8.00%
Inflation	2.40%	2.75%	2.25%	3.00%	2.25%	2.75%
Real return	4.85%	5.25%	5.25%	4.50%	5.35%	5.25%

Note: Data from system Comprehensive Annual Financial Reports of FY 2017.

Nonetheless, we conducted a sensitivity analysis to determine the impact of imposing a 7.25% discount rate, using a rough rule-of-thumb to increase the estimated normal cost for all systems except Colorado PERA, which already uses 7.25%. We chose this rate because the capital market assumptions used to calculate TDF investment returns are consistent with a 7.25% return on a pension fund that has the same investment policy as CalSTRS.³² Increasing the normal cost increases the projected account balance in a hypothetical 401(k). As **Table B.6** shows, using a lower discount rate makes little difference in the percentage of teachers who will earn pension benefits that exceed what they would have accumulated through an idealized 401(k) account: 74.6% compared to 76.6% under the baseline that uses the currently adopted discount rates. Even in Connecticut and Texas, for which we increased 401(k) contributions by nearly 18% compared to the baseline costs, the share of teachers better off with the existing pension only decreased by 1.7% and 3.9%, respectively.

Table B.6
Share of Teachers Who Are Better Off with Pension than Idealized 401(k)—Sensitivity Analysis

State	Baseline Results with Current Discount Rate	Results with Estimated Plan Cost for 7.25% Discount Rate	Difference (Percentage Points)
Colorado	81.0%	81.0%	0.0%
Connecticut	84.2%	82.5%	-1.7%
Georgia	71.9%	71.4%	-0.5%
Kentucky	73.6%	72.8%	-0.8%
Missouri	81.6%	81.2%	-0.4%
Texas	76.4%	72.5%	-3.9%
6-State Average	76.6%	74.6%	-2.0%

Note: Colorado PERA currently uses a 7.25% discount rate.

Mortality Assumptions

As noted above, we used retirement system post-retirement mortality assumptions to convert DB pension benefits into 401(k)-equivalent values, and to calculate the annual annuity payments resulting from money purchase benefits. Given the marked longevity of public sector workers, especially teachers, relying on general population mortality rates such as Social Security Administration life tables results in significant underpricing of annuities for teacher retirement system members. Thus, we reconstructed post-retirement mortality rates for each retirement system based on information about base tables and improvement scales provided in the FY 2017 actuarial valuation report for each plan, unless the plan provided the full mortality tables.

Most retirement systems assume that mortality rates will decrease (participants will live longer) over time. Some systems use a static projection that applies mortality improvement assumptions up to a fixed horizon, e.g., 2028. In such cases, we simply used the mortality rates computed from the static projection. This results in a single set of annuity purchase rates by retirement age.

Some systems rely on a dynamic projection, which generates a distinct mortality table for each birth year/retirement age combination. We simplified the projection in order to accommodate our underlying benefit model, which is based on entry age rather than birth year. Specifically, we assumed a single hire year by offsetting mortality rate projections by the average years of service among active members. For instance, if active members currently average ten years of service, we set back the mortality improvement projection by ten years, effectively assuming that everyone was hired in 2007 (ten years prior to the 2017 fiscal year). This adjustment was used solely for pricing annuities. The result is a table of conservatively priced annuity rates for each entry age/retirement age combination.

Endnotes

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- 5 N. Rhee and W.B. Fornia, "How Do California Teachers Fare under CalSTRS? Applying Workforce Tenure Analysis and Counterfactual Benefit Modeling to Retirement Benefit Evaluation," *Journal of Retirement*, v5n2, 2017; N. Rhee and W.B. Fornia, "Are Most Teachers Better Off with a DB Pension, 401(k), or Cash Balance Plan? The Case of CalSTRS," *In The Public Interest*, Issue 17, Society of Actuaries Social Insurance & Public Finance Section, July 2018, pp. 4-11.
- 6 On pensions as a teacher retention incentive, see C. Weller, "Win-Win: Pensions Efficiently Serve American Schools and Teachers," National Institute on Retirement Security, October 2017, <https://www.nirsonline.org/reports/win-win-pensions-efficiently-serve-american-schools-and-teachers/>.
- 7 Rhee and Fornia 2016, 2017, 2018, op cit.
- 8 For Colorado, we analyzed the PERA School Division. Administration of the Denver Public Schools retirement plan was taken over by PERA in 2010. The pension was closed to new members, and existing members were given the choice to either switch to PERA School Division or remain in the old benefit structure. Denver public school teachers hired since the merger belong to PERA School Division.

- 9 National Education Association, "Characteristics of Large Public Education Pension Plans," NEA, 2016, <http://www.nea.org/assets/docs/CharacteristicsLargePubEdPensionPlans2016.pdf>.
- 10 McGee and Winters 2013, op cit.; Aldeman and Rotherham 2014, op cit.; McGee and Winters 2015, op cit.; Aldeman and Johnson, 2015, op cit.; Johnson and Southgate 2015, op cit.; Costrell and McGee 2016, op cit.; Lueken 2017, op cit.
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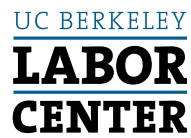
29 Weller 2016, op cit.

30 A significant share of active members in the retirement systems analyzed in this study belong to tiers with more generous benefits and a lower normal retirement age than the tiers modeled in this study. This means that our estimate of the percentage of teachers who are better off with the existing pension than a hypothetical 401(k) is lower than is actually the case. Connecticut TRS and Missouri PSRS only have one tier, so this is not an issue for those states.

31 See Barber and Odean, 2011, op cit.; Frazzini and Lamont, 2008, op cit.; R. Kinnel, 2013, op cit.

32 In 2016, CalSTRS forced down its discount rate by 0.25% below its expected return, to 7.00%, as an additional measure of conservatism. This is not reflected in the sensitivity analysis.

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