Handbook of the Economics of Education

Chapter: Teacher Pensions

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Abstract

Most educators in the United States receive retirement compensation via a subnational defined-benefit (DB) pension plan. These plans exert strong "pull" and "push" incentives over the course of the career and concentrate teacher retirements at relatively early ages compared to other professions. They also impose sharp penalties on geographically mobile teachers. Teacher pensions are a large and growing cost of public education. There are several reasons for the rising costs, but the biggest reason is that the unfunded liabilities of most plans are growing. The growth in unfunded liabilities is facilitated by the decoupling of contributions and benefits at the individual level, and represents a shift of wealth from young to older teachers in the United States. In response to fiscal pressures some states are changing their plans, primarily for new teachers.

1. Introduction

Unlike most private-sector professionals, public educators in the United States are primarily enrolled in defined-benefit (DB) pension plans (Hansen, 2010; National Council on Teacher Quality, 2012). Upon retirement from a DB plan, educators receive a lifetime annuity that depends on their earnings and years of service. Although in principle DB plans can be designed so that annuity payments are directly tied to contributions over the course of the career, as a matter of practice payments and contributions are not linked in the plans that cover the majority of public educators. The de-coupling of benefits and contributions at the individual level allows for peculiar labor supply incentives, and the cross-subsidization of retirement benefits across contemporaneous workers and generations of workers.

Substantial resources are devoted to fund educator retirement benefits. Based on data from 2012, on average across states teachers and their employers contributed approximately 20 percent of salaries to teachers' pension plans, and unfunded liabilities in state plans totaled over $300 billion (National Council on Teacher Quality, 2012).[1] Moreover, economists have argued that fund-reported cost and liability estimates are too low because the value of promised benefits has been understated by actuaries (Biggs, 2011; Biggs and Richwine, 2014; Novy-Marx and Rauh, 2009, 2011, 2014). Consistent with this concern, pension debts have been rising in most public pensions plans in the United States over the past decade, even in plans where educators and employers have ultimately made all actuarially-required contributions (e.g., Missouri)..

[1] Based on combined employer-employee contribution rates to state pension plans for educators as reported by the National Council on Teacher Quality (2012). This figure excludes health insurance costs during retirement, which are important because most educators retire well before eligibility for Medicare (typically age 65) and many states and school districts provide access to free or heavily subsidized health insurance for retirees. Health insurance has become a large retirement benefit cost for many states and school districts but we do not examine retiree health benefits in this chapter. We refer interested readers to Clark (2010).

In addition to being of interest due to their increasingly precarious financial situation, educator pension plans are also of interest because of the labor supply incentives that they create. The labor supply incentives are driven by compensation *backloading*, which is a term used to describe the feature of typical plans that wealth accrues very slowly early in the career and then very quickly toward the end of the career, as we illustrate below. The backloading has implications for initial recruitment and also creates powerful "pull" incentives that encourage educators who have already entered the profession to remain in teaching until they become eligible for pension collection. Once a teacher reaches collection-eligibility the incentive structure shifts – usually sharply – and similarly strong "push" incentives encourage retirement. In many states, an educator who enters teaching in her mid-20s and works continuously will feel the "push" of the pension system by her mid-to-late 50s. The push effect is independent of promotions. Holding career duration and pension-plan mobility constant, a principal or superintendent will be pushed out by the pension system at the same point in the career cycle as a classroom teacher (Koedel, Ni and Podgursky, 2013).

Concerns about the lack of workforce-quality benefits of teachers' pension incentives, along with the cost and fiscal volatility of many plans, have prompted the development of alternative retirement compensation options for public educators. As of 2012, 13 of the 50 states offered educators something other than a pure DB pension plan. Alternative options across states include defined contribution (DC) plans, hybrid DB-DC plans, choice plans (where educators can choose from some combination of DB, DC and hybrid plans) and cash-balance plans. While the overwhelming majority of public educators continue to be covered by a traditional DB plan, the retirement-benefit landscape in education is changing.

The purpose of this chapter is to provide an overview of pensions for public educators, with a primary focus on the United States. We begin by describing how educator pension plans work and reviewing the current policy landscape. Next we discuss the labor supply incentives created by backloading and review the literature on their implications for retirement behavior and workforce quality. Then we discuss the fiscal condition of educator pension plans and how their fiscal health has evolved over time, followed by an overview of recent efforts in some states to reform educator retirement systems and the tradeoffs that have come with the reforms. We conclude with a brief discussion of educator retirement plans in other developed countries, although we are not aware of any research studies on educator pensions outside of the United States.

2. Background on Retirement Benefit Plans For Educators

Compensation for educators in any year can be divided into current and deferred components (Lazear, 1986). Current compensation consists of direct salaries and other contemporaneous benefits like health coverage. Deferred compensation is delivered through pension payments and retiree health coverage. The latter is important for teachers because many retire before reaching the age of eligibility for Medicare (typically age 65), but we focus on the pension share of deferred compensation in this chapter.

As noted above, educators in 37 of the 50 states are covered by pure-DB pension plans. Of the remaining 13 states, 5 offer hybrid plans, which include DB and DC components, 6 others offer a choice between DB and alternative plans (e.g., DC and hybrid plans), one state (Kansas) offers a cash-balance plan, and one state (Alaska) enrolls all educators in a DC plan.[2] Most of these plans

[2] These summary statistics are as reported by the National Council on Teacher Quality (2012). They describe the situation for teachers newly-hired in 2014 or later, with the exception of the cash-balance plan in Kansas which is effective in 2015. In some cases, incumbent teachers are in different "tiers" of plans, with the hybrid or DC plans only covering younger teachers. Thus, the vast majority of incumbent and experienced teachers are covered by traditional DB plans. In 28 states (e.g., California, Texas, Ohio), teachers have their own plans, while in 23 others

are "contributory" in that both the educator and employer (either the district or the state) make a contribution toward funding the retirement benefit. Teacher contributions are exempt from federal and state income taxes.

2.1 How Traditional, Final-Average-Salary DB Pension Plans Work

The DB plans that cover most public educators are typically administered at the state level and share a common structure (Costrell and Podgursky, 2009). The following general formula is used to determine the annual benefit at retirement:

$$B = F * YOS * FAS \quad (1)$$

In (1), *B* represents the annual benefit or annuity, *F* is a formula factor, which is usually close to two percent, *YOS* indicates years of service in the system, and *FAS* is the teacher's final average salary, commonly calculated as the average of the final few years of earnings.[3] After retirement, the benefit (*B*) is also generally adjusted for inflation. In some states inflation adjustments are by statute and in others they are *ad hoc*. Often there are caps in place limiting cumulative adjustments.

The vesting period varies between 3 and 10 years across state plans. Vesting periods have been on the rise in recent years (National Council on Teacher Quality, 2012). Once vested, educators are eligible to collect a pension upon retirement. If an educator leaves the system prior to vesting she usually loses all employer contributions on her behalf but can recoup her own contributions, typically with interest.

The official "normal retirement age" in most plans is between ages 60 and 65. Normal retirement can also be entirely service-based – e.g., at 30 years of system service. However,

(e.g., Florida, Maryland, Tennessee) teachers are in consolidated plans with other state and local workers. In addition, some teachers are in municipal teacher plans (e.g., Chicago, New York, Saint Louis, Kansas City).

[3] By contrast, the annuity payment in the national Social Security system is based on earnings averaged over an entire work career. These are called career-average DB plans. Other plans, common in private firms that have retained DB plans, are called cash balance plans. These allow pension wealth to accrue smoothly over an employee's work life. See Barr and Diamond (2010).

educators can often retire and collect benefits earlier. For example, the Missouri state pension plan has two provisions that facilitate retirement prior to the normal retirement age of 60. The first provision is referred to as "25-and-out." The 25-and-out provision allows an educator to retire and begin collecting benefits immediately, at any age, as long as she has 25 years of system experience. There is a modest penalty associated with retirements via 25-and-out, but it is less than what would be actuarially appropriate. The second provision that facilitates early retirement in Missouri is referred to as the "rule of 80". The rule of 80 states that whenever a teacher's combination of age and experience sums to 80, she can retire and begin collecting benefits immediately and without penalty. This means, for instance, that a teacher who begins work at age 24 and works continuously would be eligible for full retirement benefits at age 52 with 28 years of experience. Most DB plans have similar provisions that facilitate retirements before the normal age.

In 27 of the 37 DB-only states, educators are also enrolled in Social Security. States covered by Social Security tend to have less-generous and less-costly pension plans given that educators and districts also contribute to Social Security.[4] Social Security is also a DB plan. However, unlike standard state plans, wealth accrual in Social Security is not heavily backloaded (as we illustrate below).

Two features of the benefit structure in state plans – both absent from Social Security – generate the backloading (Costrell and Podgursky, 2009; Friedberg and Turner, 2010). First are the generous early-retirement provisions similar to the ones we describe above for Missouri that are found in most plans. These provisions can substantially increase the number of years that career

[4] State and local employees (and thus public school teachers) were excluded from Social Security when the act was passed in 1935. However, amendments to the act in 1950, 1954 and 1956 allowed states to elect Social Security coverage for state and local workers if the workers voted to join (Munnell, 2000). Recent data from the Bureau of Labor Statistics shows that 27 percent of public school teachers are not covered by Social Security (U.S. Department of Labor, 2008, Table 5).

educators can collect pension payments, but are of little to no value to educators who leave the system early. Second is the way that final average salary is calculated. The *FAS* calculation is frozen at the time of exit and therefore does not account for inflation or life-cycle pay increases. This penalizes teachers who exit a plan mid-career. To illustrate, consider two individuals who end up with the same wage profile over the course of their respective 30-year careers. The first individual stays in the same system and her final payment is equal to *30*F*FAS*, where *FAS* is calculated using her last few years of earnings. The second individual switches systems after 15 years. Her final payment comes from the two systems and is equal to $\{15*F*FAS_1 + 15*F*FAS_2\}$, where FAS_1 is her final average salary at the time of her exit from the first system, unadjusted for inflation or career-cycle pay increases.

2.2 Pension Wealth Accrual in Traditional DB Plans

For analytic tractability we define "pension wealth" as the present value of the future stream of pension payments earned at a given point in an educator's career. Pension wealth at time *s*, with collection starting at time *j* where $j \geq s$, can be calculated as:

$$\sum_{t=j}^{T} Y_t * P_{t|s} * d^{t-s} \tag{2}$$

In (2), Y_t is the annual pension payment in period *t*, $P_{t|s}$ is the probability that the individual is alive in period *t* conditional on being alive in period *s*, *d* is a discount factor, and we set *T* to 101.[5]

Figure 1 shows wealth-accrual profiles for a representative 24-year-old entrant into teaching based on the rules from three state plans: California, Missouri and Tennessee. We discount to the point of entry using a discount rate of four percent for the calculations in the figure.[6]

[5] At the point of initial collection Y_t is equal to the baseline benefit "*B*" from equation (1). Y_t can be cost-of-living adjusted during retirement.

[6] We parameterize a starting wage and wage-growth profile to produce the graphs in Figure 1. The starting wage and wage-growth profile are the same for the representative teacher in all three states for ease of comparison, and are determined by a wage function that we estimate as a cubic in teaching experience using administrative data from

Teachers in Tennessee are enrolled in Social Security and we show wealth accrual with and without Social Security benefits for the Tennessee teacher. Teachers in California and Missouri are not enrolled in Social Security.

The formula factors at full retirement (i.e., at the maximum value) in California, Missouri and Tennessee are 0.024, 0.025 and 0.015, respectively.[7] Full retirement eligibility for the representative teacher is reached at the aforementioned rule-of-80 in Missouri and at 30 years of service in Tennessee. In California full retirement eligibility is not reached until age-65, which is more than a decade later than in Missouri and Tennessee based on the work profile of our representative teacher. Thus, California teachers can collect full benefits for fewer years than their counterparts in the other states (this is not true just in the comparison with Missouri and Tennessee – most states allow teachers to retire and begin collecting full benefits earlier than in California).[8]

(Figure 1 here)

All three plans shown in Figure 1 have a 5-year vesting rule – prior to vesting teachers accrue no pension wealth. Once vested, the marginal returns to work in terms of pension-wealth accrual are initially small and then rise quickly in all three plans. In Missouri, the pension wealth profile has a plateau. The spike at the front end of the plateau in Missouri coincides with the attainment of eligibility to collect benefits via 25-and-out, which comes with a penalty that is less

Missouri. The California teacher is from the newest tier of that system – currently retiring teachers in California are covered under a more generous and more backloaded set of rules. We assume that the Tennessee teacher began contributing to Social Security at age-22, prior to entering the pension system at age-24.

[7] The formula factor is increased from 0.0250 to 0.0255 for all service years for teachers in Missouri who put in at least 31 years of service. This benefit is reflected in the figure by the small bump in the pension-wealth profile at 31 years of work, which effectively extends the "plateau" in the graph.

[8] In all three states benefits can be collected prior to reaching full retirement eligibility but with a reduced formula factor.

than what would be actuarially fair. To see why the 25-and-out provision generates such a large increase in pension wealth, consider the marginal value of that year of work for our representative entrant. If she exits after 24 years of service and prior to 25-and-out eligibility, she will not be eligible to collect her first pension payment until age 56 under the rule-of-80, but by working the 25th year she can collect her first payment at age 49. The extra seven years of payments facilitated by the 25-and-out provision, even after accounting for the collection penalty, drive the rapid pension-wealth increase at the front end of the plateau. The peak in Missouri occurs when the teacher has worked continuously up to the rule-of-80 amount, which is how she receives the most pension payments under full benefit eligibility (i.e., without a collection penalty).

The Tennessee plan is characterized by a pension-wealth spike at 30 years of service and a similar spike is present in the California plan.[9] In all three plans, pension-wealth begins to decline once educators become eligible for full retirement (i.e., eligible for collection at the maximum formula factor). Wealth accrual declines because benefits cannot be collected while working. While the value of the monthly pension payment can be increased by post-eligibility work (which can raise final average salary and years of service), the gains from the larger payments are more than offset by losses owing to forgone pension payments. We return to this point below when we discuss labor supply incentives.

The profiles in Figure 1 are discounted to the point of entry into teaching at age-24. Changing the discounting horizon does not affect the shapes of the curves but does change the pension-wealth values on the vertical axis. Based on our parameterized real discount rate of four

[9] Interestingly, Tennessee has a 25-and-out clause as well. However, unlike in Missouri the penalty for collecting under 25-and-out in Tennessee accounts for the age of collection – the younger the educator, the sharper the penalty. Accounting for age in an actuarially appropriate manner wipes out the pension-wealth gains from collection under 25-and-out in Tennessee. Thus, there is no deviation from the smooth accrual rate at 25 years of service in Tennessee.

percent, the multiplicative factor required for discounting the profiles to age-55 rather than age-24 is approximately 3.4. Thus, the discounting horizon affects the strength of the incentives at different points in the work life. The graphs in the figure illustrate wealth accrual from the perspective of a new entrant. However, a teacher who is making a labor supply decision at a later stage in her career will face larger, and hence more potent, incentives.

The profile for the Tennessee teacher also provides the opportunity to compare the state plan to Social Security. Wealth accrual in Social Security is fairly flat owing to the Social Security system having a very different formula for determining benefits.[10] However, there is still a prominent spike in the Tennessee plan overall even after accounting for Social Security. This is because late in a teacher's career, the present discounted value of the stream of pension payments from the state plan far exceeds that of the Social Security payments. In essence, the Social Security benefit simply shifts up the peaked wealth accrual profile in Tennessee.

Finally, Figure 1 shows that total pension wealth for Missouri educators at the end of the career is much larger than in California and Tennessee, even when one accounts for Social Security in Tennessee. There are several factors that contribute to the gap in the profiles across states. In the comparison with Tennessee, the issue is that the Missouri formula factor is much higher. In the comparison with California, while the California teacher can work up to a formula-factor that approaches the Missouri formula factor (0.024 versus 0.025), the Missouri teacher can retire with the high formula factor at a much younger age, which results in many more years of pension payments. Put differently, the California teacher must choose between more payments at a lower

[10] The flatness of the Social Security curve after age 65 also derives from the fact that since 1999 it has been possible to collect Social Security and continue working without penalty. As noted in the text, it is generally not possible to collect DB teacher pensions and continue working under the same plan. Teachers are free to "retire" in one state plan (e.g., New York) and take a teaching position covered by another state plan (e.g., New Jersey).

formula factor or fewer payments at a higher formula factor, whereas the Missouri teacher gets more payments and a high formula factor.[11]

2.3 Defined-Contribution, Hybrid, Cash-Balance and Choice Plans

Alaska is the only state that exclusively offers a DC-only plan for educators, although educator retirement compensation in states with hybrid and choice options also have DC components. Retirement benefits in DC plans are entirely portable and directly tied to contributions. DC plans are best thought of as individual retirement savings accounts – there is no backloading. Educators are responsible for making their own investments in DC plans, although the investment choice set is typically constrained. DC plans come with investment risk for educators, which is a limitation relative to the DB alternative (where the investment risk is borne by the system). However, as noted by Koedel, Ni and Podgursky (2014), DB plans are also risky, albeit in different ways (see discussion below).

As of 2012, educators in five states – Indiana, Michigan, Oregon, Rhode Island and Virginia – were enrolled in hybrid retirement plans (National Council on Teacher Quality, 2012). Hybrid plans combine a less-remunerative and less-costly DB plan with a DC plan.[12] The DB component works like a traditional DB plan. Benefits are backloaded in hybrid plans owing to the DB component, but because the absolute level of pension-wealth in the DB component is lower, the impact of the backloading is reduced. Per above, the DC component is not backloaded.

In Kansas, all teachers hired after January 1, 2015 are enrolled in a cash-balance plan. Although rare in K-12 education, the Teachers Insurance and Annuity Association of America

[11] Other aspects of the plans also contribute to differences in wealth accrual across states including the number of years used to calculate final-average-salary (the benefit becomes more valuable when fewer years are used) and differences in how cost-of-living adjustments are applied during benefit collection across plans. We do not go into detail about these other features of the plans in the text but they are incorporated into the graphs in Figure 1.

[12] In hybrid plans teacher contributions are typically put in the DC plan and employer contributions in the DB plan.

(TIAA) has similar plans that cover higher education employees. Cash balance plans guarantee members a minimum rate of return, which is an implicit and generally desirable feature of traditional DB pension plans (at least from the pensioner's perspective). Cash-balance plans are like DC plans in sense that the value of the retirement benefit is directly tied to contributions, but unlike DC plans, employees do not make investment decisions (plan assets are managed by the pension fund) and do not bear investment risk. In addition, cash balance plans offer automatic annuitization at retirement. Because of the direct link between contributions and benefits, wealth accrual in cash-balance plans is not backloaded and benefit cross-subsidization across teachers does not occur..

Finally, six states - Florida, Louisiana, Ohio, South Carolina, Utah and Washington – offer educators a choice of retirement plans. The choices vary across states but include some combination of DB, DC, hybrid and cash-balance plans.

3. Incentives for Educators

Between pure-DB, hybrid and choice states, the vast majority of public educators earn some or all of their retirement compensation via a DB pension plan. The prevalence of the DB pension structure in education stands in sharp contrast to the private sector, where fewer than one in five workers has DB pension coverage (Wiatrowski, 2012).

The wealth-accrual profiles in Figure 1 illustrate the "pull" and "push" incentives that are built into these plans. The pull incentives on the front end encourage educators to remain in the system until reaching collection eligibility. Drawing on Lazear (1986), the conventional economic rationale for the backloaded compensation profile is to deter shirking. The idea is that if it is costly for employers to monitor effort, backloading can be used to raise the employee's cost of shirking under the assumption that if the employee is caught, she will be terminated prior to receiving the backloaded compensation. However, this rationale is a poor fit for public school teachers because

most teachers earn tenure very early in their careers (as early as after two years of teaching – see Hanushek, 2009), which makes the threat of losing a pension not credible.[13]

Shortly after educators become eligible to collect a pension, the wealth-accrual profile begins to slope downward as educators enter the push region. Wealth accrual turns negative because benefits cannot be collected while working. Put differently, upon reaching collection eligibility there is an immediate spike in the opportunity cost of continued work.[14] Collection-eligible individuals who continue working could earn a fraction of their salary – typically a substantial fraction – without working at all or while working in an alternative career (even in a school covered by a different pension system). As noted above, although pensioners can increase the value of their monthly pension payments by increasing their years of service and final average salary even after they become collection eligible, the increased value in pension payments caused by delaying retirement is more than offset by the fact that payments are forgone via continued work. Thus, there is a "push" from the pension system to retire. The mostly flat, then rapidly rising, and then declining profile of pension-wealth accrual exacerbates differences in career salary profiles for teachers relative to other professionals as documented by Vigdor (2008).

There is consensus in the literature that educators' retirement choices are responsive to the above-described pension incentives. Harris and Adams (2007) show that teachers exit into retirement at much younger ages relative to workers in other professions, which they note is

[13] Lazear (1986) analyzes the efficiency rationale for this type of incentive structure in the context of a competitive firm. A key factor in his model is the role of a pension as a performance bond to discourage shirking. See Jacob (2011) and Weisberg et al. (2009) for information about the infrequency with which tenured teachers in public schools receive unsatisfactory ratings and/or are removed from the classroom. An additional, general rationale for long-term government retirement plans is that they facilitate improved intergenerational risk sharing (e.g., see Gollier, 2008; Schiller, 1999). The literature on the intergenerational risk-sharing benefits of public retirement plans is less concerned with the specifics of plan design and the political economy, which are the primary focus of this chapter.

[14] To offset the push incentive some states utilize deferred retirement option plans (DROPs). These plans allow educators to "retire" and continue working without losing pension benefits.

consistent with teachers responding to their "push" incentives, but they find little evidence to suggest that the "pull" incentives affect mid-career attrition. Using data from Arkansas, Costrell and Podgursky (2009) show that retirements spike when teachers become eligible for full benefit collection, and that the distribution of retirements shifts in response to a change in retirement-eligibility rules. Costrell and McGee (2010) extend this work and find significant effects of pension wealth accrual and peak values on retirement behavior for Arkansas teachers. Furgeson et al. (2006) study a temporary pension incentive program in Pennsylvania and find that an increase in teachers' retirement benefits generates a substantial behavioral response in terms of retirements. Fitzpatrick and Lovenheim (2014) also study a temporary incentive program, this time in Illinois, and similarly to Furgeson et al. find that teachers were highly responsive. Brown (2013) uses data from a permanent pension reform in California and finds significant changes in the clustering of retirements by age corresponding to pension rule changes. Finally, Ni and Podgursky (forthcoming) estimate a structural "option value" model of teacher retirements for Missouri teachers. They find that the Missouri DB plan concentrates retirements much more than would be the case under a plan with smoother wealth accrual.

The evidence on the responsiveness of teachers to their retirement incentives is consistent with the larger literature on workers in other occupations. For example, Coile and Gruber (2007) use nationally-representative data from the Health and Retirement Study to show that Social Security and private pension benefits are significant determinants of retirement behavior. Chan and Stevens (2008) use the same data and also conclude that workers' labor supply decisions depend on their pension incentives. Their study additionally highlights the important role that information plays in influencing behavior. In particular, Chan and Stevens (2008) show that well-informed individuals appear to be much more responsive to their pension incentives than ill-

informed individuals. However, while ill-informed individuals may act as if they are unresponsive to their pension incentives, they are actually responding to their perceived but incorrect understanding of how their pensions work.[15]

In addition to understanding responsiveness in general, economists are interested in determining whether responsiveness is related to teacher productivity. The nature of the relationship between the DB incentive structure and productivity is critical to understanding how pension plans influence workforce quality overall. At the point of initial recruitment, the effect of the pension structure on workforce quality depends on how teachers who differ by quality value deferred retirement compensation. We are not aware of any direct empirical evidence on how DB pensions influence selection into teaching, but economic theory suggests that heavily backloaded retirement plans will not be an effective recruiting tool for high-ability young teachers. One reason is that the backloading penalizes mobility and research shows that higher-ability individuals place higher *ex ante* probabilities on exiting teaching (Murnane and Olsen, 1990; Podgursky, Monroe and Watson, 2004). Consistent with these earlier studies, Chingos and West (2015) and Goldhaber and Grout (forthcoming) find that when given a choice, teachers who choose DC plans with mobile benefits are, on average, moderately more effective as measured by value-added to student test scores.[16] The evidence that higher-ability teachers prefer mobile retirement benefits is in line with the association between worker ability and mobility in the broader labor market. For example, Groes et. al. (2015) show that across the top 80 percent of the ability distribution, job mobility is positively related to worker productivity. While direct evidence on selection is unavailable; taken together, the body of indirect evidence suggests that the backloaded structure of wealth accrual in

[15] Older studies showing that workers' retirement decisions are responsive to their accumulation of retirement wealth include Samwick (1998) and Stock and Wise (1990).
[16] In Goldhaber and Grout (forthcoming) the choice is between a DB and hybrid plan rather than a full DC plan.

DB pension plans will be unattractive to higher-ability individuals relative to the alternative of a more mobile retirement benefit plan, or simply higher salaries.

Conditional on entry into the workforce, the effects of the pull and push incentives on workforce quality depend on whether educator responsiveness is related to effectiveness. Starting with the pull incentives, quality will be improved if educators who would otherwise leave but are retained in teaching by these incentives are more effective than their replacements. One reason to expect a positive quality effect is that, on average, experienced teachers are more effective than novices (e.g., see Clotfelter, Ladd and Vigdor, 2006; Hanushek and Rivkin, 2006). Thus, all else equal, retention incentives that maintain a higher overall level of experience in the workforce should result in higher student achievement. However, the positive empirical relationship between educator effectiveness and experience is not a sufficient condition to ensure that the pull incentives will positively affect workforce quality. The quality effect depends on the effectiveness of educators whose behavior is altered by the DB structure and this is a selected group. For example, it may that an experienced educator who wants to leave teaching, but chooses to stay only because the pension-related costs of changing jobs are high, is not as effective as the average teacher of the same experience level.

Some empirical evidence is available on the effect of the pull incentives on workforce quality. Koedel, Podgursky and Shi (2013) divide teachers in Missouri into groups based on their observed retirement behaviors and compare teachers who are the most likely to have been retained by the pension system to other experienced teachers. In math they find that retained teachers are *less* effective than their similarly-experienced peers and cannot be statistically distinguished from novices, while in reading retained teachers are no more effective than their similarly-experienced peers but outperform new entrants. Fitzpatrick and Lovenheim (2014) use an early-retirement

incentive program in Illinois in the late 1990s to provide evidence on the workforce-quality effects of the pull incentives. The Illinois program, which was temporary, offered teachers in the pull region of the pension structure the opportunity to exit the system prior to reaching collection eligibility without incurring the substantial cost that would normally come with doing so. Put differently, the program temporarily dulled the early-exit penalty in the Illinois pension system that generates the pull incentive. Fitzpatrick and Lovenheim show that a large number of experienced teachers elected to exit teaching via the program. However, they report that the program did not reduce test scores and likely increased them, despite the fact that it reduced the overall experience of the workforce. Thus, research evidence to date does not suggest that the pull incentives raise workforce quality and it is more consistent with these incentives resulting in the retention of less effective teachers on average.

Next we turn to the push incentives. If effectiveness declines after a certain age, it would support the use of the push incentives in DB pension plans to improve workforce quality (Lazear, 1986). However, two aspects of how the push incentives work call into question the likelihood that they are designed to improve quality. First, the push incentives in many plans begin to take effect immediately, or almost immediately, after the pull incentives cease. There is a logical inconsistency in connecting the pull and push incentives to workforce quality unless we believe that the experience-effectiveness profile turns very sharply from increasing to decreasing for most individuals. Compounding this issue is that in many states full retirement eligibility occurs at a "rule-of-X," where different educators hit "X" with different combinations of age and experience. This further implies that the pull and push incentives are not targeted around a central turning point in the relationship between age, experience and productivity.

A second reason to be skeptical that the push incentives are positively affecting workforce quality by incentivizing older workers with declining skills to leave is that in many states, educators feel the DB pension push at young ages – as early as their mid-to-late 50s. In fact, Podgursky and Ehlert (2007) report that the national median retirement age for teachers in 59 (based on data from the 2005 Schools and Staffing Survey).[17] Given that professionals in other sectors of the economy typically work much longer, it is not clear why productivity in education would begin to decline at such an early age.

The only study of which we are aware that provides direct empirical evidence on the effect of the push incentives on workforce quality is Koedel, Podgursky and Shi (2013). They find that, on average, teachers who are observed working into the push region of the pension incentive structure are no more or less effective than other experienced teachers in terms of raising achievement and are more effective than novices.

4. Pension Plan Financing

As noted in the introduction, a substantial share of educational resources is devoted to funding educator retirement benefits. The National Council on Teacher Quality (2012) reports that as of 2012, combined employee-employer contribution rates to fund educator retirement benefits ranged from 15 to 29 percent of earnings across states. These contribution rates are determined by actuarial calculations, which economists have argued rely on assumptions that lead to a significant understatement of true pension costs (Biggs, 2011; Biggs and Richwine, 2014; Novy-Marx and Rauh, 2009, 2011, 2014).

Figure 2 reports benefit costs for retirement, including Social Security, contributed by employers as a percent of salary for public school teachers and private sector managers and

[17] Harris and Adams (2007) also report steeply increasing exit rates for teachers starting in their mid-50s.

professionals (these data are taken from the United States Department of Labor). Note that these costs do not include any employee contributions nor do they include employer payments for retiree health insurance. Two patterns are clear from the figure. First, benefit costs for public school teachers, which are currently 19.5 percent of salaries, are substantially above those for private sector professionals and managers. Second, private-sector costs have been relatively flat over the previous decade whereas the costs for public school teachers exhibit a clear increasing trend.[18]

(Figure 2)

The primary driver of the pension cost increases for educators is amortization of previously-accrued unfunded liabilities.[19] The National Council on Teacher Quality reports that unfunded liabilities increased between 2009 and 2012 in all but seven states. In 2013, the average percentage of earnings for a new entrant into teaching devoted to cover the "unfunded actuarially accrued liability" (UAAL) in state plans was roughly 10 percent.[20]

One factor driving the cost increases is that most pension plans have failed to meet their assumed rate of return – usually 8 percent – on their investment portfolio. In practice, the pension funds (and their actuaries) set contribution rates for teachers and employers by discounting liabilities at the assumed return on the portfolio (again 8 percent). However, because future liabilities must be paid, most economists believe that liabilities should be discounted or priced using a risk-free or low-risk rate (as is the federal requirement for private sector plans). Several

[18] Data from the U.S. Department of Labor on public school teacher pension costs (excluding Social Security) imply a 2014 pension cost of just over $1000 per student, up from an inflation-adjusted $500 per student in 2005. As a percent of per student spending, pension costs grew from 4.9 to 8.9 percent over this period. See Costrell (2015).
[19] States generally follow standards of the Government Accounting Standards Board (GASB) with regard to reporting the liabilities of pension plans. Annual required contributions by GASB standards have two components. The first is "normal cost", which measures the cost of new pension obligations incurred in a given year. The second is payment sufficient to amortize the unfunded liabilities of the pension plans over thirty years.
[20] This figure is based on the authors' own calculations using data collected in actuarial valuation reports from state plans, supplemented with data from the Public Plans Database maintained by the Center for Retirement Research at Boston College.

studies have argued that actuarial cost calculations understate liabilities and that actual costs are much higher than what has been reported (Biggs, 2011; Biggs and Richwine, 2014; Novy-Marx and Rauh, 2009, 2011, 2014), which is consistent with the persistent accumulation of pension debt by state plans even in plans that ultimately make all actuarially-required contributions.

States have responded in a number of ways to the weakening fiscal condition of educator pension plans. Some have increased required contribution rates. Others have created alternative plans as described above. Still others have created new, less-generous "retirement plan tiers" for incoming teachers that provide lower net benefits. These changes can be generally characterized as cross-cohort wealth transfers from young and not-yet-hired teachers to older, more senior teachers.[21]

A fundamental feature of DB pension plans that has contributed to their persistent underfunding is that for any individual benefits are not directly tied to contributions. Among other things, this facilitates benefit promises that do not require direct funding at the time when promises are made. Glaeser and Ponzetto (2014) develop a political economy model and show that this feature of pension financing promotes an inefficient allocation of resources where compensation via pensions is too high. In short, their model shows that politicians can appeal to pensioners without scaring off taxpayers by improving pension benefits. The key assumption in their model is that pension packages are "shrouded," meaning that public-sector workers better understand their value than ordinary taxpayers.

[21] Another disturbing shift has been toward increasing risk in the investment portfolio in an effort to meet or exceed the assumed rate of return and close funding gaps. Over the last sixty years, state and local pension funds (including teachers) have moved from investment portfolios which were overwhelmingly comprised of low risk government securities, to portfolios in which equities and "alternative investments" such as real estate and hedge funds are more prevalent (Pew Charitable Trusts and the Laura and John Arnold Foundation, 2014).

Shoag (2014) draws a parallel between modern public pension fund financing and a period of substantial debt-funded public investment in infrastructure in many states in the mid-19th century. Similarly to pension benefit promises today, the borrowing for the infrastructure projects increased long-term government liabilities. Projections of the proceeds from the infrastructure projects via presumed subsequent economic growth factored prominently into state budgets for repayment at the time. After a debt-fueled period of public investments in canals and state-chartered banks that ended in the 1840s, eight states and the territory of Florida had defaulted. Shoag (2014) reports that the combined debt of state governments by the early 1840s stood at over $200 million, up from $12.8 million in 1825.

As in the early 19th century with states' various canal and bank-charter projects, a rationale for not immediately funding pension promises is that the investment return on assets can be used to pay off liabilities when they come due. This rationale is appealing politically if politicians discount future deficits at high rates, as it allows them to promise benefits without making immediate payments to cover the costs. This type of situation is particularly dangerous if unrealistic investment returns are required in order for liabilities to be covered like with the infrastructure boom discussed by Shoag (2014), and as has been asserted by economists with regard to the assumed rate of return used by the actuaries for most public pension plans.

The fact that pension promises can be made without setting aside direct funding facilitates political gaming as in Glaeser and Ponzetto (2014). Koedel, Ni and Podgursky (2014) provide direct evidence of such gaming in the educator pension plan in Missouri. They examine a series of enhancements to the Missouri plan in the late 1990s and early 2000s. The enhancements greatly improved the benefit formula for educators, and similar enhancements were made in most states during the same time period (National Conference of State Legislatures, 1999, 2000, 2001). One

reason for the widespread enhancements is that the stock market was producing abnormally high returns, which in the short run resulted in many pension funds showing an actuarial surplus. That is, the accounting books for many funds indicated that they had more assets than would be required to pay off future liabilities. A prudently-operated fund would use excess returns generated during periods of above-average market performance to offset periods of below-average market performance. But because the system is easy to manipulate inter-temporally, it facilitates rent capture when asset returns in the short run exceed long run expectations.

Koedel, Ni and Podgursky (2014) show that the enhancements to the Missouri state pension plan were structured to transfer resources to experienced teachers and away from young teachers and teachers who had not yet entered the workforce. The key feature of the enhancements that facilitated the transfer is that they were implemented retroactively and required no additional contributions from educators. For example, one enhancement increased the formula factor in Missouri from 0.023 and 0.025. At the time when the legislation was enacted, all teachers were eligible for the improved formula factor despite the fact that experienced teachers had made all previous contributions to fund a less remunerative benefit.

This is an example of the inter-generational risk of DB pension plans, which is driven by the ability of current generations to extract resources from the system that they do not need to pay for and can leave for future generations to make up. Another form of wealth transfer that occurred in the late 1990s and early 2000s was from young teachers and future generations of teachers toward state governments. This type of transfer occurred when a number of state governments did not make necessary funding contributions on the behalf of employees when investment returns were high enough to mask the behavior (e.g., California, Illinois).

An additional problem with the disconnect between benefit funding and benefit promises is that plans hold risky assets without pricing the risk (Biggs, 2011; Biggs and Richwine, 2014; Novy-Marx and Rauh, 2009, 2011, 2014). This practice is encouraged by voluntary accounting standards (promulgated by the Government Accounting Standards Board, GASB) that allow funds to discount future liabilities at the expected rate of return on the investment portfolio without considering risk. Thus, one way for funds to improve the asset-to-liability ratio is to shift to a riskier portfolio with a higher expected return. Because of compounding, even small changes in the expected rate of return over time can result in large changes in the apparent fiscal health of a pension plan. The cost of the risk borne by many state pension plans, which has thus far gone unaccounted for, will be left for future generations to address.

5. The Changing US Pension Landscape

The problems surrounding the financing of DB pension plans for educators, coupled with concerns that these plans offer little in the way of workforce quality improvement, have led some states to implement alternatively structured retirement plans as discussed in Section 2.[22] All of the available alternatives – hybrid, choice, DC, cash-balance – share the common feature that they move a larger share of educators' retirement compensation into plans where benefits are tied directly to contributions. In DC and cash-balance plans, benefits are tied entirely to contributions. Choice and hybrid plans still maintain some disconnect between benefits and contributions for the share of retirement compensation delivered through the DB component, but the introduction of the non-DB component weakens the disconnect for total retirement compensation.[23]

[22] It should also be noted that there is evidence that teachers value a marginal dollar of retirement benefits at much less than a marginal dollar of salary. In an analysis of an Illinois pension enhancement that permitted active teachers to purchase additional service years (and hence higher retirement annuities) at a very steep discount, Fitzpatrick (forthcoming) finds that teachers implicitly valued a marginal dollar of retirement benefits at less than twenty cents.
[23] Chingos and West (2015) and Goldhaber and Grout (forthcoming) show that in an environment with retirement-plan choice, a large fraction of teachers choose the more mobile option (either a pure DC plan as in Chingos and West or a hybrid plan with a DC component as in Goldhaber and Grout).

Another response to pension funding problems has been to maintain the DB pension structure but with reduced benefits for new members. Benefits have been reduced in a number of ways. For example, since 2009 eleven states have increased the vesting period (National Council on Teacher Quality, 2012). Teachers who do not vest lose their employer contributions, which can then be used to support pension payments for the remaining workforce. States have also changed plan rules in ways that reduce the accrual of pension wealth for new teachers. Examples include raising the age or experience requirement for collection eligibility and changing the formula factor for new teachers.

Illinois is an example of a state that kept the DB structure but made sharp cuts in the benefit accrual rate for new teachers (those hired on or after January 1, 2011, who are referred to as "Tier II members"). The cuts in Illinois include a later retirement age, a cap on annual cost-of-living adjustments (COLAs) for retirees, and a cap on the allowable final average salary. The result is a much slower rate of pension wealth accrual. Indeed, Costrell and Podgursky (2011) show that a typical Tier II teacher in Illinois entering at age 25 will accrue no net pension wealth until age 51. Note that the benefit cut comes with no relief in terms of contribution rates – Tier I (experienced) and Tier II (new) teachers both contribute 9.4 percent of their salaries toward their pensions.[24]

Finally, the increasing prevalence of public schools of choice in K-12 education merits brief mention on the issue of pensions. Charter schools in 16 states can currently opt out of state pension plans. When given the opportunity many charters schools do opt out, but the share varies from state to state. Charter schools that opt out are free to develop their own retirement plans and evidence suggests that they tend to implement DC plans similar to many private employers (Olberg

[24] A number of other states have also made reforms along these lines in recent years including Alabama, Louisiana and New York (e.g., see National Conference of State Legislatures, 2012).

and Podgursky, 2011). The effect of charter school innovation in this area has not been rigorously examined in research to date.

6. Teacher Pensions in other OECD Countries

The World Bank describes a "three pillar" taxonomy for characterizing national retirement systems. The first pillar represents a mandatory public system, such as the United States Social Security system. The second pillar represents privately-managed, mandatory savings plans, and the third pillar privately-managed voluntary plans (Baily and Kirkegaard, 2009). Teachers in most OECD countries are members of "first pillar" national plans, similarly to public school teachers in the United States who are also enrolled in Social Security. They are also typically part of "second pillar" mandatory plans. The latter are generally DB plans and the final-average-salary structure found in the United States is common. However, some of the more problematic features of U.S. final-average-salary DB plans have been eliminated or ameliorated in other countries.[25]

Consider two types of mobility for teachers: geographic and occupational. The pension-relevant aspect of geographic mobility in the United States involves crossing pension boundaries, which for all practical purposes coincide with state lines. Geographic mobility is less of an issue in many other countries because occupational plans cover an entire nation. But even in countries with multiple subnational plans, such as Canada, province-wide plans can accommodate a great deal of geographic teacher mobility because provinces are so large and because there is reciprocity between provinces, unlike among U.S. states. For example, the Ontario teacher pension plan, a

[25] We only briefly touch on the international pension landscape because we could not find any research on occupational plans for educators outside of the United States (although there have been many comparative studies of the retirement benefit systems of various countries, these tend to focus only on the large public plans and not on educator plans specifically – e.g., see Baily and Kirkegaard, 2009, Barr and Diamond, 2010; Muir and Turner, 2011; Organization for Economic Cooperation and Development, 2013; Turner, 2010).

final-average-salary DB plan resembling many U.S. state plans that covers roughly 300,000 active and retired teachers, has reciprocity arrangements with other Canadian provinces.[26]

In the case of occupational mobility, most occupational DB plans in other countries are not based on an annuity formula that freezes nominal salaries at the time of exit. Again using the Ontario plan as an example, the final average salary is increased annually by a cost of living index for teachers who exit covered employment. No such adjustment is made in state plans in the United States, where any cost-of-living adjustments occur only after collection begins. For example, in the United States if a teacher exits the profession 20 years prior to reaching collection eligibility her final average salary is frozen at her nominal earnings at the time of exit. Only after she begins collecting does her annuity increase with any cost-of-living adjustments. Returning to the discussion in Section 2.1, incorporating cost-of-living adjustments prior to collection eligibility for early exiters in U.S. plans would greatly reduce the degree of compensation backloading.

It is not clear why educator pension plans in the United States impose such harsh penalties on mobile teachers relative to plans in other countries. The explanation may be political, as U.S. plans redistribute pension wealth from young and mobile teachers to senior teachers and administrators (Costrell and Podgursky, 2009; Koedel, Ni, Podgursky, 2014). Representatives of the latter groups dominate the governing boards of these plans and are likely to be more politically influential. The interests of young and mobile teachers are better represented in pension plan design abroad – how this influences workforce quality and the fiscal sustainability of subnational pension plans outside of the United States merits attention in future research.

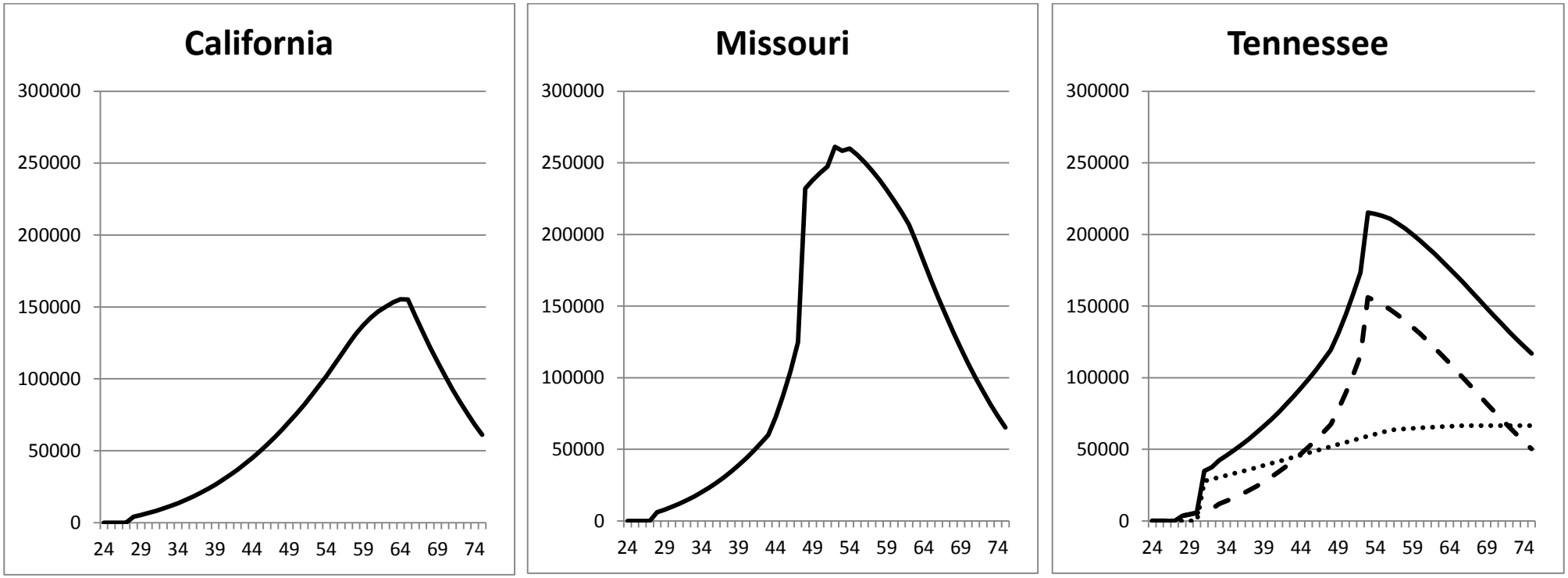
[26] http://www.otpp.com/documents/10179/712513/-/4fc371f9-5c3f-41c0-a625-a4512020113e/Annual+Report.pdf

7. Conclusion

In contrast to most private-sector professionals, the vast majority of public educators in the United States are enrolled in final average salary defined-benefit pension plans. There is nothing inherent to the structure of defined benefit plans that requires compensation to be backloaded. The United States Social Security system, for example, uses career average earnings in calculating the pension annuity. However, the state DB plans that cover most public educators are characterized by significant compensation backloading, primarily as a consequence of using final average salary to compute retirement annuities and offering service-based options (sometimes in combination with age) to facilitate retirements before the normal age. The backloading creates a somewhat unique incentive structure in education (shared with other public sector occupations) that merits greater consideration in labor-based education research.

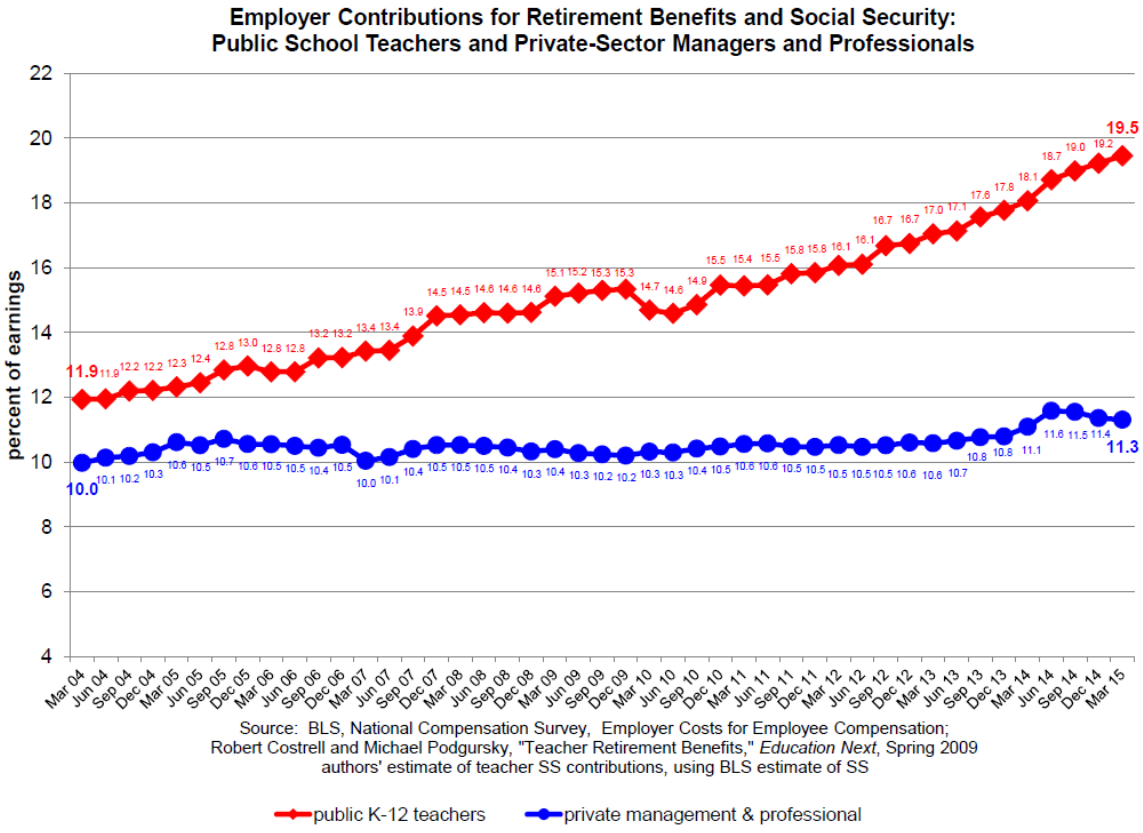
Combined with their peculiar labor incentives, the weak fiscal condition of most state pension plans covering educators ensures that pension reform will continue to be an important topic for education research and policy in the United States moving forward. Because such a large share of the total resources currently devoted to educator compensation is devoted to financing current DB pension plans, reforming these plans has the potential to meaningfully affect the educator labor market along a number of dimensions, including how teachers are recruited and retained, and when they retire. Pension reform also has the potential to free up additional resources for K-12 schools that can be used in a more transparent way – for example, to improve teacher salaries and/or to purchase additional educational inputs.

Figure 1. Pension Wealth Accrual over a Work Life for a Representative Teacher Who Enters Teaching at Age-24 in Three DB Pension Plans (California, Missouri and Tennessee).



Notes: The vertical axis in all three graphs shows pension wealth discounted to the age of entry (age-24) and in 2013 dollars. The horizontal axis shows age. Pension wealth is calculated using a discount rate of 4 percent. The representative teacher in each graph enters teaching at age-24 and has the same starting salary and salary growth over the career. Teachers in Tennessee are enrolled in Social Security. The dotted line represents wealth accrual in Social Security for the Tennessee teacher assuming that she began paying into Social Security at age 22, two years prior to entering teaching. The dashed line represents wealth accrual in the state pension plan. The solid line indicates total pension wealth, which is the sum of the two. Teachers in California and Missouri are not enrolled in Social Security and thus total pension wealth is equal to pension wealth accrued through the state plan.

Figure 2. Employer Pension Costs as a Percent of Salary: Public School Teachers and Private Sector Managers and Professionals



Source: Costrell and Podgursky (2009), updated at:
http://www.uaedreform.org/downloads/2013/12/quarterly-employer-contribution-chart-update.pdf

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