REFORMING TEACHER PENSION PLANS:
THE CASE OF KANSAS, THE 1ST TEACHER CASH BALANCE PLAN

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ABSTRACT: The ongoing crisis in teacher pension funding has led states to consider various reforms in plan design, to replace the traditional benefit formulas, based on years of service and final average salary (FAS). One such design is a cash balance (CB) plan, long deployed in the private sector, and increasingly considered, but rarely yet adopted for teachers. Such plans are structured with individual 401(k)-type retirement accounts, but with guaranteed returns. In this paper I examine how the nation's first CB plan for teachers, in Kansas, has played out for system costs, and the level and distribution of individual benefits, compared to the FAS plan it replaced. My key findings are: (1) employer-funded benefits were modestly reduced, despite the surface appearance of more generous employer contribution matches; (2) more importantly, the cost of the pension guarantee, which is off-the-books under standard actuarial accounting, was reduced quite substantially. In addition, benefits are more equitably distributed between short termers and career teachers than under the back-loaded structure of benefits characteristic of FAS plans. The key to the plan's cost reduction is that the guaranteed return approximates a low-risk market return, considerably lower than the assumed return on risky assets.

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1. INTRODUCTION AND SUMMARY

Teacher pension plans are in crisis. Costs have been rising faster than revenues for some time. As Figure 1 shows, employer contributions for public K-12 retirement benefits have grown (in 2020 dollars) from $547 per pupil in 2004 to $1,571 in 2020, more than doubling the share of current education expenditures, from 4.8 percent to 11.3 percent (Costrell 2020b). This rise in pension contributions has almost certainly crowded out salary hikes and other classroom expenditures. Indeed, the rise in contributions has not even gone to improve pension benefits for current teachers – they have been driven by payments on rising pension debt for unfunded benefits previously earned (Aldeman 2016; Moody and Randazzo 2020).

Under such circumstances, exacerbated by tightening revenues since the Great Recession of 2008-09, states have looked to modify or reform their pension plans, and will be under even greater pressure to do so in the wake of the Covid Recession of 2020. In most such cases, states have retained the structure of traditional plan design, while trimming benefits (e.g., raising the retirement age for new hires, cutting cost-of-living allowances, or raising teacher contributions). A growing number of states, however, have looked to reform their plan design, moving away from benefit formulas based on years of service and final average salary (FAS), toward plans with some form of individual retirement accounts. These have included hybrid plans, coupling a new 401(k)-type account with a scaled-back FAS component (NASRA 2020). Another design based on individual retirement balances is a cash balance (CB) plan, the subject of this paper.

A CB plan accumulates contributions in a teacher's individual retirement balance over her career, but, unlike a 401(k) plan, provides a guaranteed rate of return. The smooth accumulation of retirement balances is markedly different from FAS plans, where the value of benefits grows very slowly over most of a teacher's career, before accelerating as she approaches retirement. Among other implications, this means CB offers greater portability for a mobile workforce (Costrell and Podgursky 2008, 2009, 2010a, 2010b). The private sector converted hundreds of FAS plans to CB decades ago, arguably due to this feature, more so than any cost savings (Clark and Schieber 2004; Coronado and Copeland 2004; Johnson and Uccello 2004). Such non-fiscal considerations, however, have not generally swayed teacher plan reforms.

Rather, it was fiscal distress that led Kansas to adopt the nation's first CB plan covering teachers.[1] In this paper I examine how that plan has played out for the level and distribution of benefits and system costs. The cost-saving potential of CB plans has certainly helped frame debates in other states. Fiscally distressed New Jersey has been debating CB proposals that would cover teachers since 2015 (Dawsey 2015; Steyer 2018, 2019). Cost-cutting CB proposals were also considered in Pennsylvania, Maryland, and Montana, following the recession of 2008-09 (Fehr 2011; Costrell 2012, pp. 22-23). States with CB plans for state and/or local employees have considered extending them to teachers; Kentucky enacted such an extension, in 2018, but the reform was struck down on procedural grounds. Thus, the lessons from Kansas' CB plan, which applies both to teachers and state employees, may be increasingly pertinent in the aftermath of the Covid Recession, as more states face even greater fiscal distress than previously. As I will show in this paper, those lessons are both subtle and far-reaching.

The case of Kansas illustrates how CB plans include levers that allow states to cut employer contributions for currently earned benefits below the advertised (albeit notional) match

[1] Kentucky implemented a CB plan for state employees, effective 2014. Louisiana enacted a CB plan for state employees, effective 2013, but it was struck down judicially on grounds of legislative procedure. Nebraska adopted a CB plan for county and state employees, effective 2003, but never enacted one for teachers. California has a supplemental CB plan for teachers, and Texas has statewide CB plans for county and municipal governments. (NASRA 2020). The cities of Memphis and Omaha have also adopted CB plans (Aubry and Wandrei 2020).

rate. I explain how this is done, through actuarial details that are not widely understood. Unlike FAS plans, which depress contributions using a high assumed rate of return on the plan's investments, CB plans often do so by virtue of the *spread* between the plan's assumed return and its embedded interest rates on individual balances. There are two such possible spreads: prior to retirement and, separately, but less well known, *after* retirement. These and other details reduce employer contributions, even as the stated match may seem more generous. To be sure, the employer contribution for currently accruing benefits in Kansas had already been reduced to minimal levels under the preceding FAS plan, so there was not much left to cut by adopting the CB plan. But the *surface* appearance of a rise, to more generous employer-funded benefits, may have eased the political difficulty of enacting the cut that was actually implemented.

This result pertains only to the cost of benefits that is on-the-books for determining contributions under current public sector actuarial practice. Far more significant, I find, was the reduction in the system's cost of risk, which is off-the-books. This cost arises from funding guaranteed benefits with risky assets. Current practice calculates costs by taking the assumed return on risky assets as certain, even though returns are highly volatile and uncertain.[2] This leaves off-the-books the extra costs that would be calculated under private sector accounting rules, based on the much lower return for low-risk bonds. Over time, this practice has led many public FAS plans to incur large unfunded liabilities, rising payments on pension debt, and other, intangible costs, all of which are off-the-books as the benefits are being earned. These costs represent the value of the FAS pension guarantee, and they are quite large.

[2] Public plan actuarial reports have started to provide some limited sensitivity analyses, recognizing the risk in assumed returns. All plans are now required by the Government Accounting Standards Board to report their unfunded liability under returns that are one percentage point higher or lower than assumed. There is, however, no requirement to report the variation in annual cost under different returns. Kansas has reported the annual cost for returns that are one-half percentage point higher or lower than assumed in its 2018 and 2019 valuation reports (see more on this in note 28 below). By comparison, the bond returns used under private sector accounting rules are about four percentage points lower than the corresponding assumed returns for public plans.

CB plans also provide a guaranteed benefit: a minimum return on account balances, rather than an FAS formula that is unrelated to any form of investment returns. The key to Kansas' cost reduction was to set the guaranteed return close to a low-risk market rate, well below its assumed return on risky assets. The spread moves some of the cost off-the-books, but the full cost is much reduced from that of FAS to begin with, by virtue of its structure. By guaranteeing only a low-risk rate of return on retirement balances the full employer cost is approximately the same as the plan's stated employer match – a reasonably competitive rate. This exceeds the actual contributions, but is much lower than the full cost of the FAS plan. The reduction in costs from adopting CB – on-the-books and, especially, off-the-books – is the most novel point of this paper. Indeed, the overall reduction in the implicit cost of risk borne by the employer may form the strongest case for states considering replacing FAS plans with CB.

Finally, the value of individual benefits is more broadly distributed in the CB plan than in the FAS plan it replaced. This has long been understood for the value of benefits that are on-the-books. Under FAS plans, career teachers receive benefits worth far more than the contributions made on their behalf, while the converse is true for short termers and mobile teachers; CB plans tie benefits much more closely to contributions (Costrell and Podgursky 2010a, 2010b; Costrell and McGee 2010; McGee and Winters 2013; Aldeman and Rotherham 2014; Lueken 2017). In this paper, I show that the value of the pension guarantee, off-the-books, is also distributed more broadly under CB. Indeed, these distributional features are linked with each other, so the reduction in inequity of benefits, both off-the-books and on-the-books, is quite pronounced.

The plan of the paper is to first briefly review the basic features of traditional FAS pension benefits and funding, and to then introduce the concept of individual normal cost rates, developed in Costrell and McGee (2019). I present the methodology for estimating these rates and apply the concept to the FAS plan for Kansas teachers hired before 2015. This will show the level and distribution of benefits. In the next section, I explain the elements of CB plans, and how their benefits and funding differ from FAS plans. I will then specifically derive and portray the distribution of individual cost rates under the CB plan for Kansas teachers hired since 2015, to compare with the FAS system it replaced. I also compare it with the more generous system of benefits that the stated plan features may seem to imply. Specifically, I closely examine the features of the CB plan, as implemented, that reduce the employer contribution. To this point, the analysis is restricted to the costs that are on-the-books. I then turn to the full cost under each plan, including the off-the-books cost of risk – the value of the pension guarantee. I will depict the distribution of individual values of the pension guarantee under Kansas' FAS plan, using the method of Costrell (2020a), and compare it with the CB plan. Although the main reason for the lower cost under Kansas' CB plan has been summarized above, I will explain the significance of some pertinent actuarial details in the plan's implementation. I then show how the full cost could be reduced further, without materially raising contributions or reducing the guaranteed return on retirement balances, and with enhanced transparency, by a reasonable reduction in the assumed rate of return. Concluding remarks summarize key policy considerations.

2. Traditional Pensions and Individual Normal Cost Rates: Kansas' FAS Plan

2.1 Basics of FAS Pension Benefits and Pension Funding

Under traditional FAS plans, pensions are calculated using a formula of the form:

(1) annual pension payment = (years of service) × "multiplier" × (final average salary).

This formula applies to teachers hired before January 1, 2015 under the Kansas Public Employees Retirement System (KPERS). Specifically, the "multiplier" is 1.85% per year of service, and final average salary (FAS) is defined over the 5 highest years of salary. Thus, for example, a 25-year-old entrant working to 65 with salary averaging $60,000 over the last 5 years, retires with a pension calculated as: 40 years of service × 1.85% per year × $60,000 = $44,400.[3] KPERS teachers are eligible for "normal retirement" at age 65, after 5-year vesting, or age 60 with 30 years of service. Teachers who exit early, but do not cash out (see below), must generally defer the pension to the normal retirement age.[4] However, FAS is frozen upon exit, so the pension due at retirement does not rise over the years of deferral (a feature that differs from CB plans, as discussed below). As one works longer, approaching retirement age, FAS rises and the years of deferral diminish, adding to the impact of greater years of service. As a result, the growth in the annual pension accelerates – the accrual of benefits is said to be "back-loaded."

Teachers also have the option of cashing out upon exit, forgoing any future pension. If so, they receive the cumulative value of the employee (but not employer) contributions, with accumulated interest at the rate set by KPERS, 4.00 percent. Teachers who leave before vesting, without the expectation of returning, would certainly take the refund because it is the only benefit to which they are entitled. Teachers who leave after vesting, but too young to draw a pension, may either take the refund or leave the money in the fund to draw a pension in the future, upon reaching retirement age. KPERS assumes that vested teachers choose the refund or the deferred pension to maximize the value of their benefits, an assumption I follow below.

How are these benefits funded? Pension benefits are funded by contributions that have two pieces: (1) contributions that pre-fund benefits as they are earned, known as "normal costs;" and (2) contributions to pay down pension debt, from previously earned benefits that were not

[3] The FAS plan I examine is KPERS Tier 2, for teachers hired between July 1, 2009 and December 31, 2014. This plan (unlike those hired earlier, in Tier 1) has no Cost of Living Adjustment (COLA), so the annual pension payment remains unchanged for life. The CB plan, for those hired starting in 2015, is KPERS Tier 3.
[4] There is an "early retirement" provision, under which the benefit is "reduced actuarially." For our purposes, that means the annual cost of pre-funding the benefit is the same as if the pension were deferred until normal retirement.

fully funded (unfunded liabilities). The calculation of normal costs rests on the plan's actuarial assumptions. It is when those assumptions fail, particularly the return on investments (Costrell 2018c, 2018d), that unfunded liabilities ensue, as will be discussed in later sections. We begin, however, by focusing on normal costs, as calculated using the plan's assumptions.

2.2 Uniform and Individual Normal Cost Rates, and Cross-Subsidies

Normal cost contributions are levied as a percentage of salary, both on employees and employer – effectively, a uniform fringe benefit rate. For example, the annual joint contribution (employer and employee together) to fund newly earned benefits may be 15 percent of each teacher's salary. These contributions are designed to fund future retirement benefits as they are earned, for the system *as a whole*. However, the annual cost of benefits for *individual* teachers may deviate widely from this overall average. For example, early leavers may earn benefits worth 5 percent of salary per year while the benefits of career teachers are worth 25 percent. In effect, there is a large cross-subsidy – 10 percent of pay – from the contributions by or for early leavers to help fund the benefits of career teachers. This is a big part of the funding plan. There are also other patterns of cross-subsidies, e.g., from younger to older entrants or vice versa.

More formally, consider an individual of type (e,s), where e is the age of entry and s is years of service. For each type (e,s), one can identify an individual normal cost rate, n_{es} that generates a stream of contributions sufficient to fund the individual's future benefits.[5] Expressed as a percent of annual salary, the normal cost rates are analogous to contribution rates for defined contribution (DC) plans. Part of the normal cost is covered by the employee contribution and the remainder is the employer-funded benefit, analogous to a DC employer match. As shown in

[5] The normal cost rates also depend on date of entry, since that governs whether KPERS' Tier 2 FAS plan or Tier 3 CB plan applies. For purposes of comparison, I estimate entrants' n_{es} under each plan as if they were entering today.

Costrell and McGee (2019),[6] n_{es} is the ratio of the present value (PV) of benefits, B_{es}, to the PV of earnings, W_{es} (both evaluated at entry):

(2) $n_{es} = B_{es}/W_{es}$.

This is the rate that, applied to the individual's annual earnings over her career, would prefund her benefits – an *individual* fringe benefit rate for pensions. In FAS plans, these individual cost rates vary widely by age of entry and years of service.

The joint contribution rate for normal costs is *uniform* across employees. It is set to n^*, the weighted average of individual costs, calculated to fund the benefits of the whole entering cohort. The weights for n_{es} are the share of type *(e,s)* in the cohort's PV of earnings.[7] The deviations $(n_{es} - n^*)$ are positive and negative, comprising a system of cross-subsidies, as the cost of funding an individual's benefit exceeds or falls short of the uniform contribution rate, n^*. By the nature of averages, the weighted sum of cross-subsidies $(n_{es} - n^*)$ is zero: the negative cross-subsidies provided by the losers fund the positive cross-subsidies enjoyed by winners.

2.3 Methodology for Estimating Individual Normal Cost Rates for Kansas FAS Plan

I estimate the individual normal cost rates, $n_{es} = B_{es}/W_{es}$, for entry ages, e = 25, 30, 35, 40, and 45, and each potential length of service, s, assuming continuous employment from entry to exit, up to age 70. I base the calculations on KPERS' FAS benefit formula, as detailed above, and the plan's actuarial assumptions for school employees (KPERS 2020a). The actuarial assumptions include wage growth and mortality rates. These assumptions and the benefit

[6] In that paper, s denotes age of exit, but the math is identical, with a simple transformation.
[7] These are not the exact weights used in actuarial practice, but are consistent with the approach (see Costrell and McGee 2019, Appendix).

formula allow me to estimate B_{es}, the PV of the stream of pension payments; W_{es}, the PV of her stream of earnings; and, therefore, the individual normal cost rates, $n_{es} = B_{es}/W_{es}$.

Specifically, salary growth assumptions include 3.50% annual general wage increase, plus 8.00% in year 1, declining to 2.55% in year 5 and zero beginning in year 21.[8] These growth rates allow me to estimate the wage trajectory for an individual of any type (e,s). From that series one can directly calculate W_{es}, the PV of her stream of earnings. We can also calculate FAS and, using the benefit formula, the annual pension for such an individual. From the mortality rates, we can construct survival probabilities to any age, needed to weight the annual discounted pension payments, to estimate the PV, B_{es}.[9] For unvested individuals and others who take the refund instead of the pension, B_{es} is the PV of the employee's contributions (6.00 percent of earnings) accumulated with the interest granted by KPERS (4.00 percent). The estimates of both W_{es} and B_{es} are normalized per dollar of entry wage, so the entry wage is not needed to calculate their ratio, $n_{es} = B_{es}/W_{es}$.

To aggregate the individual normal cost rates into the overall normal cost rate, n^* (and to calculate "winners" and "losers" below), we need to calculate a cohort's joint frequency distribution of types, p_{es}, so that we can calculate each type's share of the cohort's PV of earnings, $(p_{es}W_{es})/(\sum_e\sum_s p_{es}W_{es})$. The distribution of types can be constructed from the actuarial assumptions on exit rates, together with the distribution of entry ages. For each entry age e, the conditional frequency of years of service s, $p_{s|e}$, is found by constructing the probability that one is still working at s, from KPERS' assumed exit rates, and then differencing that series. The joint frequency, p_{es}, is given by $p_{s|e} \cdot p_e$, where p_e is the distribution of entry ages. The distribution

[8] These can be thought of as movements along a salary grid coupled with inflation of the grid itself.
[9] I take the KPERS mortality assumptions for female school employees (which tilts the cost up a bit), but omit death and disability benefits, as well as administrative expenses, which account for about 5 percent of normal cost.

of entry ages can be estimated using the KPERS (2020a) data on age and service, given in 5-year-bins. This estimate is imprecise, but the aggregates are relatively insensitive to the p_e's.

Finally, and most importantly, all PV's are discounted to entry at KPERS' assumed return on investment, 7.75 percent. As will be discussed at length in later sections, this is, at the very least, a risky assumption, and will be reconsidered below.

2.4 Variation in Normal Cost Rates By Years of Service and Age of Entry

Figure 2 depicts the individual normal cost rates, n_{es} by years of service, s, with different curves for entry ages e = 25, 30, 35, 40, and 45. Consider first an entrant of age 25 (the most common of these entry ages), with normal cost rates depicted by the heavy black solid curve. Prior to vesting (at five years), and for some years beyond, the benefit is the refund of employee contributions. The normal cost rate, therefore, starts at the employee contribution of 6.00 percent: the curve begins at the horizontal line representing that rate. The cost rate then gently declines, falling slowly below the employee contribution rate. That is because the interest credit of 4.00 percent is below the fund's assumed return, r = 7.75 percent. The gap represents the arbitrage profits the plan assumes it will earn on employee contributions. The contribution rate needed to cover the refund falls as these assumed profits accumulate.

At a certain point, the pension becomes more attractive than the refund. A 25-year-old entrant reaches that point by 27 years of service, at age 52; by then, the pension would still be deferred to age 65, but exceeds in PV the value of the employee refunds. Beyond that point, the normal cost rate rises as the deferral to 65 becomes shorter. When she reaches 30 years of service, at age 55, she needs only defer the first draw to age 60: the series of benefit payments is extended forward by 5 years. That is why the normal cost rate to fund the benefit jumps at that point. It continues to rise from 30 to 35 years of service (ages 55 to 60), as the deferral to age 60 grows shorter. Beyond 35 years of service, at age 60, there is no deferral: the first draw is immediate. Each year of further delayed retirement is a year of forgone pension payments. Thus, even though the pension payment continues to grow with additional years of service and higher FAS, the normal cost declines, due to the decreasing number of years the pension will be paid. Overall, the normal cost rate varies from 3.7 percent to 9.3 percent. Since 6.0 percent is paid by the member, the normal cost of the employer-provided benefit ranges from -2.3 percent to +3.3 percent, among 25-year-old entrants.

The normal cost rate also varies with age of entry, generally rising with later entry. Once vested, older entrants have fewer years to wait until they are eligible for their pension. Thus, as Figure 2 indicates, their normal cost curves start rising earlier, and reach their peak sooner. Moreover, that peak rate – reached upon exiting at the age of eligibility – will also generally be higher for older entrants. That is because their FAS – on which the pension is based -- will be higher relative to their average career earnings, since their career is shorter. These later entrants expand the upper range of normal cost rates up to a maximum of 12.4 percent from the minimum of 3.7 percent. The overall normal cost rate, n^*, is about 7.7 percent, by my estimate.[10] Since employees pay 6.0 percent, the employer normal cost is 1.7 percent.

Advocates of traditional FAS pension systems, such as teachers' unions, public pension industry groups, and others, defend the apparent inequities as a rational human resource policy to reward longevity and, thereby, incentivize retention.[11] As we see in Figure 2, Kansas' FAS plan does reward longevity for any given entry age, by awarding pension benefits at a higher annual

[10] As it happens, my estimate closely matches KPERS' estimate for school employees (net of death and disability payments and administrative expense), although their estimate is for all tiers, not just Tier 2.
[11] See, for example, Rhee and Fornia (2016, 2017), Rhee and Joyner (2019) and Weingarten (2017).

rate, up through ages 60 or 65. However, the empirical evidence for the impact of such back-loading on retention is, at best, mixed.[12] Thus, one may well question whether the steepness of the curves, their sharp jumps, or their late-career decline are effective for human resource goals. Nor is it clear what purpose is served by the variation across entry ages, which is quite large for any given length of service, as depicted by the vertical spread in Figure 2. As we shall see, CB plans offer a less idiosyncratic system of rewarding longevity. Indeed, there is apparently some evidence that Kansas' switch to CB has raised late-career teacher retention. That is the implication of the newest actuarial assumptions (KPERS 2020a, p. 159), based on the system's most recent experience study. KPERS now distinguishes retirement rates for members of the CB and FAS plans, with lower rates under the CB plan, for ages 60 – 66.

2.5 Cross-Subsidies in the FAS Plan

For Kansas, the variation in normal cost rates, from 3.7 to 12.4 percent, with n^* = 7.7 percent, generates a range of cross-subsidies from −4.0 percent to + 4.7 percent (see Table 1 for summary of cross-subsidy statistics). These cross-subsidies are built into the funding plan. For those individuals below the uniform normal cost line in Figure 2, the plan is counting on using some or all of the employer contributions to help finance the benefits of others. The beneficiaries of the cross-subsidies (i.e. those whose benefits cost more than the uniform rate assessed for all teachers) are concentrated on those who exit beyond their late 50's, whether it is with a career of service or after late entry. These winners comprise 19 percent of entrants, but they account for 52 percent of the cohort's PV of earnings, by virtue of their generally longer

[12] For a good summary of the research, see Koedel and Podgursky (2016). Recent papers that tend to find FAS plans are ineffective tools for increasing retention include Ni and Podgursky (2016), McGee and Winters (2016), Roth (2017), Koedel and Xiang (2017), and Goldhaber, et. al. (2017).

careers.[13] My summary measure of the degree of cross-subsidization is that 2.1 percent of the cohort's PV of earnings is redistributed from losers to winners.[14] Although significant, this degree of redistribution is less dramatic than some other states' FAS plans.[15] However, the amount redistributed exceeds the entirety of the employer-funded benefit of 1.7 percent. Indeed, the winners receive an employer-funded benefit of 3.8 percent of earnings, while the losers receive no employer-funded benefit; indeed, it is negative 0.5 percent.

To summarize, Kansas' FAS plan, like others, generates wide variation in the cost of individual benefits, and an elaborate system of implicit cross-subsidies. The employer-funded benefit is relatively low, at 1.7 percent. This is the result of a series of measures taken in the face of chronic under-funding, described below, which left little more to cut upon adoption of a new plan. Nonetheless, Kansas moved to adopt a CB plan for new entrants – the nation's first such plan for teachers. What did the state have to gain? To answer this question, we first examine the level and distribution of the CB plan's normal costs, and then turn to each plan's cost of risk.

3. Individual Normal Cost Rates in Kansas' Cash Balance Plan

3.1 The Context of Fiscal Duress and Failed Reforms Under FAS Structure

Kansas' pension funding difficulties pre-dated the Great Recession. Its first steps did not address benefits. The state issued pension bonds netting $440 million for the fund in 2004 (and would issue an additional $1.0 billion in 2015); this moved unfunded liabilities off the plan's

[13] As Clark and Schieber (2004, p. 287) find, "under a traditional DB plan, a disproportionate share of benefits accrues to a relatively small number of participants, namely those who stay until they retire." See also Johnson and Uccello (2004, p. 321). By contrast, Rhee and Fornia (2016, 2017) and Rhee and Joyner (2019) argue that the losers comprise a very small portion of the active workforce, since, at any given time, most of these individuals have already left. But as explained in Costrell and McGee (2019) this represents "survivorship bias" toward the winners. Since the losses of prior leavers are excluded, the cohort's cross-subsidies do not sum to zero, as they must.

[14] This represents the weighted sum of the absolute value of cross-subsidies. The algebraic sum is zero.

[15] See Costrell (2018a, 2018b) and Costrell and Fuchsman (2018), for California, Arkansas, and Massachusetts.

books, and onto the state, which pays the debt service, instead of the districts. The state would also later begin to periodically appropriate some gaming and other funds to help cover school contribution requirements. Starting in 2009, new hires were placed in a newly created Tier 2 FAS plan that was expected to lower employer contributions, by virtue of that tier's higher employee contributions. By 2012, the fiscal situation had continued to deteriorate. The funded ratio for school employees had dropped to 49 percent. The employer contribution rate was actuarially determined to include 13.7 percent for the unfunded liability – over six times the employer normal cost as calculated at that time. A statutory cap on employer contribution hikes deferred a quarter of these payments to the future, and further deferments would be enacted later. At this point, the Legislature enacted additional cost reductions to both FAS plans, Tier 1 and 2, notably eliminating the COLA. However, the FAS system itself had proven to be quite risky. It was in this context that Kansas created a new CB plan, effective for all new hires as of 2015.

3.2 What is a Cash Balance Plan?

A CB plan is a defined benefit plan, but, similar to a DC plan, benefits are based on individual retirement balances built up from contributions and specified returns. Unlike DC plans, however, where individuals bear all the market risk on investments, under CB, the plan bears some or all of the risk. The elements of a CB plan are these (see also Table 2 for a summary comparison of Kansas' FAS and CB plan features):

- Employee contributions. These accumulate in an individual retirement account.
- Employer contribution credits. These entries also accumulate in one's retirement account, but need not be actual contributions: they may be bookkeeping entries. If so (as in Kansas), the employer credits are defined in the plan, but the employer contributions calculated to fund the benefit may be lower, as discussed below.

- Interest credits. These are applied to both employee contributions and (after vesting) employer contribution credits. These credits include a guaranteed return and possibly contingent dividends, which accumulate *prior* to retirement.

- Annuitization/lump sum distribution. The accumulated balance can be distributed as a lump sum or converted to an annuity upon retirement, with the split subject to plan rules.[16] This is the defined benefit that employers are required to fund.

- Annuitization Rate. This is the interest rate assumed to accrue on balances *after* retirement. It is used to calculate the annual annuity payment received.

As a benchmark case, consider an idealized[17] plan where the interest credit equals the plan's assumed return, the annuity is determined using the same rate, and vesting is immediate. In this simple case, employer contributions will equal the plan's stated employer credit: that *is* the employer-funded benefit, just like a DC plan's employer match. If the credit is uniform, so are the rewards – there are no cross-subsidies, as benefits accrue smoothly in tandem with contributions. Moreover, if the employer contribution credit is set to the same employer normal cost rate as the preceding FAS plan, the new CB plan would be cost-neutral. In the case of Kansas, this would be an employer contribution credit of 1.7 percent, and the normal cost curves for all entry ages would collapse to the flat uniform normal cost line in Figure 2. In practice, CB plans deviate from such a benchmark, as the Kansas plan will illustrate.

3.3 Kansas' CB Plan: The Sticker Price

The employer contribution credits under Kansas' CB plan are:

- 3.0 percent for years 0–4
- 4.0 percent for years 5–11
- 5.0 percent for years 12–23
- 6.0 percent for years 24 and up.

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[16] In private sector CB plans, employers are required to offer retirees the *option* of annuitization (Clark and Schieber 2004, p. 273; Johnson and Uccello 2004, p. 324). By contrast, the Kansas plan *requires* annuitization of at least 70 percent of the balance (limiting lump sum distribution to 30 percent), as discussed further below.

[17] I do not mean to imply the idealized form is optimal, only that it provides the simplest comparison.

On the surface, this "sticker price" schedule may seem reasonably competitive to members as the new plan is introduced – comparable to employer matches in other sectors. If we were to calculate the normal cost rates implied by these employer contribution credits, under the otherwise idealized assumptions discussed above, we would find that the employer cost rises gently from 3.0 percent to 4.7 percent, as the higher credits attached to later years accumulate.[18] Together with the employee contribution of 6.0 percent, the overall normal cost rate would be 10.0 percent, of which the employer rate would average 4.0 percent. Thus, it may appear that the CB plan is more costly to the employer than the FAS plan, as this well exceeds that plan's average of 1.7 percent. Of course, it would be extremely unlikely for a fiscally distressed system to adopt a plan with higher employer costs. Thus, we need to go under the actuarial hood to examine the features of the plan that depress the cost below the sticker price.

3.4 Kansas' CB Plan: Below the Actuarial Hood

The first such feature is vesting. As with FAS plans (and most DC plans), vesting is not immediate: for Kansas' CB plan, it is five years, the same as its FAS plan (see Table 2 for plan parameters). An individual leaving before five years of service (absent an intention to return) withdraws one's own contributions with interest, but forfeits any benefit from the employer credits that have accrued during that period. Thus, the individual normal cost rates for the CB plan are the same as those under the FAS plan prior to vesting: neither of them include any cost for the employer, so they start at 6.0 percent and dip below, due to the system's arbitrage profits between the refund interest (4.0 percent) and the assumed return. Upon vesting, the employer's contribution credits that accrued in years 0 – 4 enter the retirement balance, along with newly

[18] See Figure A.1, available in a separate online appendix that can be accessed on *Education Finance and Policy*'s Web site at www.mitpressjournals.org/efp.

earned credits. Compared with the sticker price version discussed above, I find that five-year vesting reduces the overall normal cost rate by 0.5 percentage points, from 10.0 to 9.5 percent.[19]

The second feature, which depresses the normal cost rate more substantially, is that the interest credit applied to the retirement account is below the assumed return. Specifically, the credit is 4.0 percent guaranteed, plus a dividend of three-quarters of the actual fund returns that exceed 6.0 percent over a five-year period.[20] This upside-risk-sharing provision leads KPERS to assume the interest credit will average 6.25 percent.[21] Although, to date, this has proven to be a conservatively high cost assumption,[22] it still falls short of KPERS' assumed return of 7.75 percent. Thus, importantly, the fund assumes that part of the employer cost will be covered by the cumulative difference between the assumed return and interest credit (7.75 − 6.25 percent), up to the point of retirement. It is the *spread* between the two rates, not their levels, which matters most for the actuarially determined contribution. The interval over which the fund gains from this spread is constrained by the retirement eligibility requirement. This requirement is the same for the CB and FAS plans: age 65, after 5-year vesting, or age 60 with 30 years of service.[23] Arbitrage profits between interest and the assumed return accumulate until retirement (or until first draw, deferred until the age of eligibility if one exits early), helping to fund the employer credits. Comparing the contributions required with and without this spread, I find the overall normal cost is reduced by another 2.1 percentage points, to 7.4 percent.

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[19] The method for calculating CB normal cost rates, $n_{es} = B_{es}/W_{es}$, is the same as for the FAS plan, except that B_{es} is the present value of the annuity calculated under the CB provisions, instead of the FAS pension formula. Plan parameters govern the amount of the retirement balance and the annuity calculated from that balance.

[20] The initial plan design, as enacted in 2012, provided a guaranteed interest credit of 5.25 percent, plus additional credits of 0 – 4 percent to be granted at KPERS' discretion. The guaranteed credit was reduced to 4.0 percent and formula-based dividends were introduced in 2014 legislation, prior to implementation of the plan in 2015.

[21] This was reduced from 6.50 percent in the 2016 valuation, when the assumed return was cut by 0.25 percent.

[22] For the first five years of the plan, 2015 – 2019, the dividends were 0.0, 0.0, 1.1, 0.0, and 0.825 percent, so the interest credits came to only 4.0, 4.0, 5.1, 4.0, and 4.825 percent, for a compound average of 4.38 percent.

[23] Again, there is a provision for "early retirement," but KPERS assumes members defer to normal retirement age.

The final feature is the annuity factor. Under a somewhat obscure provision, the interest rate embedded in the annuity, upon retirement, is 2.0 percentage points below the assumed return.[24] That is, upon retirement, the plan rolls the account balance forward at 5.75 percent annually, while discounting the annual payment back at 7.75 percent. This means the annuity is set with a PV that is substantially less than the account balance at retirement. By my calculation, the reduction is about 15 percent for retirement ages in the range of 60 – 70.[25] This would not matter if the retiree took the account balance as a lump sum distribution instead of annuitizing. In private sector CB plans, retirees have the option of doing so, but Kansas restricts the lump sum distribution to no more than 30 percent of the account balance (an option that KPERS assumes all members take). Thus, the impact of the annuity interest spread applies only to the 70 percent of the balance that is annuitized. Comparing the plans with and without this annuity spread, I find the normal cost reduced by another 0.7 percentage points, to 6.7 percent.[26]

Taking all the benefit provisions given above together, and the actuarial assumptions reported in the valuation,[27] I estimate the individual normal cost rates for Kansas' CB plan, depicted in Figure 3. They are relatively flat by years of service, and rise a bit with age of entry, as later entry shortens the interval over which the fund gains on the interest spread. Ranging from 5.2 to 7.8 percent, these cost rates are significantly lower than the "sticker prices" discussed

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[24] The initial legislation in 2012 set the annuity interest rate at 6.0 percent, which was 2.0 points below the assumed return at the time. The 2014 legislation tied it to whatever return is assumed. See Article 49, section 74-49, 313(a).
[25] The annuity is set to the retirement balance/the annuity factor at retirement, *AF*. *AF* is the sum over retirement years of the survival rate times the discount factor. Using an annuity interest rate of 5.75 instead of 7.75 percent shrinks the annuity by *AF(7.75)/AF(5.75)*, which I calculate at 84-87 percent, for retirement ages 60-70.
[26] To check this, note that without this spread, the normal cost is 7.4 percent, of which 0.9 is from refunds, leaving 6.5 from annuities and lump sum. With the spread, annuities are reduced by about 15 percent on the 70 percent that is annuitized, so the reduction in normal cost is $0.15 \times 0.70 \times 6.5 = 0.7$ percentage points, as calculated directly.
[27] I modify one assumption. KPERS assumes 100 percent of vested CB members leave their contribution with the system. By contrast, KPERS assumes that FAS members "take a refund if it is more valuable than the deferred annuity." I adopt this latter assumption for my CB estimates as well. This helps facilitate the comparison of the two systems, and also eliminates a discontinuous drop that would otherwise obtain for the CB normal cost rates upon vesting for young entrants. For most members, this assumption makes no difference, so the overall impact is only a slight elevation in the estimated cost rates.

above, ranging from 9.0 to 10.7 percent. While the employer contribution credits, listed at 3 – 6 percent, average 4.0 percent, the actual employer-funded benefit costs only 0.7 percent.

The plan features that defray so much of the employer credits are primarily the two spreads. The spread between the interest credit and the assumed return helps fund the account balance *before* retirement, and the spread between the annuity interest and the assumed return helps fund the benefit *after* retirement. It is worth emphasizing that it is the spread, not the level, of these rates that keeps the employer contributions low. This is very different from FAS plans. In FAS plans (as we shall see), a lower discount rate would dramatically raise the normal costs. But in CB plans, that is not the case. For example, reducing the discount rate from 7.75 percent to 4.00 percent, with no change in either spread, would only raise the normal cost by 0.3 percent: the employer normal cost of 1.0 percent would still be well below the sticker price of 4.0 percent.

Finally, compare the CB normal cost rates, in Figure 3, with the FAS rates, in Figure 2. As one would expect for a plan adopted under fiscal duress, the overall cost is reduced. There was not much left to cut from the FAS employer cost rate of 1.7 percent, but the CB plan shaved it down to about 0.7 percent. The variation in individual benefits was also reduced, as would be expected from a CB plan. It was not eliminated, as in an idealized CB (with no spreads, no vesting, and constant contribution credits), but benefits were compressed. While 2.1 percent of the cohort's PV of earnings is redistributed from losers to winners under the FAS plan, that is reduced to 0.7 percent under the CB plan (see Table 1 for more detail). As I shall argue, however, the most important impact of the move to CB lay in neither of these results, but rather the impact on the plan's cost of risk and, conversely, the value of members' pension guarantee.

4. Full Cost and Value of Kansas' Guaranteed FAS Benefits

The analysis thus far is based on public sector discounting by the assumed rate of return on risky assets (a practice that is barred from private pension accounting). There are two distinct critiques of this practice. The first is simply that the assumed return is overly optimistic.[28] This keeps contributions low in the short run, but creates unfunded liabilities and ultimately raises contributions to pay down those liabilities.[29] The second critique is that the expected return on a risky portfolio includes a premium for risk, even though the benefit is risk-free to the member. Thus, the market value of the benefit – the cost of acquiring an equivalent annuity on the open market – discounts at a risk-free (or low-risk) rate. This value far exceeds the actuarially-calculated cost, as both defenders (e.g., Rhee and Fornia 2017) and critics of FAS plans (e.g., Richwine and Biggs 2011) agree.

Where views differ is on the actual cost to the plan.[30] Defenders of these plans claim the actuarial cost *is* the full cost; there is a free lunch, so to speak, for public plans to invest in risky assets, since they can diversify the risk away over time, as immortal entities. However, this claim has been long discredited, as the "fallacy of time diversification" (Samuelson 1963). Consequently, as the finance economics literature has unequivocally demonstrated (Novy-Marx and Rauh 2009; Brown and Wilcox 2009; Biggs 2011) the full cost of a risk-free benefit is substantially understated when discounted by the expected return on a risky portfolio. The extra

[28] Public plan actuaries are often thought to offer such assumptions for the convenience of the plans, but sometimes the plan goes even further. KPERS' board recently rejected the system actuary's recommendation of a modest reduction in assumed return, from 7.75 percent to 7.50 or 7.25. Consequently, the actuary's letter submitting the 2019 valuation report (KPERS 2020a) stated that "it is our professional opinion that the set of economic assumptions used in this valuation do not comply with Actuarial Standard of Practice Number 27." See also the KPERS Board Meeting Minutes, January 16, 2020 (KPERS 2020b). This would appear to be the unstated reason that the actuarial reports for 2018 and 2019 included normal cost calculations for 7.25 and 7.50 percent (as well as 8.00 and 8.25 percent), even though it was not required, as discussed in note 2 above.
[29] These payments represent intergenerational cross-subsidies (Backes, et. al., 2016).
[30] For a summary of the points of agreement and disagreement over the discount rate, see Costrell (2020a, section 4).

costs may or may not be in the form of higher future debt payments, but are nonetheless real costs of bearing risk, e.g., the cost of fluctuating contributions (Boyd and Yin 2018) and the higher risk of insolvency, which leads to a jump in contributions to the pay-go rate (Costrell and McGee 2020). Public plans and the taxpayers that stand behind them may choose to bear the risk, but that does not eliminate the costs of providing risk-free benefits by investing in risky assets, even if these costs are unreported.[31] For the purposes of this paper, we take as uncontroversial that the market value of risk-free benefits is based on the risk-free (or low-risk) rate, and is equal to the full cost of such benefits, borne by the plan, either as future contributions or as the intangible costs of risk that people would pay to avoid. In either case, the difference between the full cost and the normal cost as calculated on-the-books is real, even though it is off-the-books.

Costrell (2020a) analyzes the distribution of the individual values of the pension guarantee under FAS plans. Each value is the difference between individual normal cost rates evaluated at the assumed return and a low-risk rate.[32] I calculate these values for Kansas' FAS plan by comparing normal cost rates at the assumed return of 7.75 percent (Figure 2) and a low-risk discount rate of 4.0 percent.[33] Each such calculation represents the annualized market value of an individual's pension guarantee. For example, individuals entering at age 25 and exiting after 35 years receive benefits that annually cost 9.3 percent of earnings, when discounted at 7.75 percent (Figure 2), but 26.1 percent when discounted at 4.00 percent. The difference is 16.8 percent of annual earnings, the value of those individuals' pension guarantee.

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[31] Biggs (2011) shows that the risk is evaluated in the market by the value of the options that would hedge that risk, and that this is equivalent to the difference between discounting at the expected return and risk-free rate.
[32] An alternative would be to evaluate the member's subjective value, using a personal discount rate. That individual discount rate often exceeds the risk-free rate, as suggested by individuals' general reluctance to buy annuities. Indeed, there is some debate as to whether personal discount rates even exceed the pension fund's assumed return, in which case members would prefer to receive more of their compensation in salaries and less in pensions (see Goldhaber and Holden 2020, and Fitzpatrick 2015).
[33] This rate is a bit less conservative than the Municipal Bond Index Rate of 3.50 percent that KPERS reports under GASB requirements to calculate a potential alternative discount rate (KPERS 2019, p. 1).

Analytically, the normal cost rate for each individual, $n_{es} = B_{es}/W_{es}$, rises with a cut in the discount rate, as B_{es} rises proportionally more than W_{es}. That is because the years of benefit follow the years of earnings, so the impact of discounting is greater. The rise in normal cost is magnified for longer years of service. This is depicted in Figure A.3 (available in the online appendix), for any given entry age, as the value of the guarantee rises with years of service up to each curve's peak (at the age of eligibility, 60 or 65), and from peak-to-peak between curves. Consequently, there is a wide spread in the value of the guarantee, ranging from zero (at zero years of service) up to 16.8 percent (the figure given for the 35-year veteran described above).

The overall value of the pension guarantee – the difference between the overall normal cost discounted at 4.00 and 7.75 percent – is substantial, 11.0 percent (Table 3, Line A3).[34] This cost dwarfs the actuarial employer-funded benefit of 1.7 percent. It includes future employer contributions to cover unfunded liabilities if the assumed return is overly optimistic, and, in any case, the intangible costs of the risk borne by the plan, as measured by the market price of risk. The value of the guarantee is highly concentrated among teachers who exit near retirement age (as with the actuarial costs in Figure 2). My summary measure of the redistribution of this benefit, from those with guarantees worth less than 11.0 percent to those with higher values (those below and above the line in Figure A.3), is 4.7 percent of the cohort's PV of earnings, on top of the 2.1 percent redistribution discussed above, for benefits that are on-the-books.

5. Full Cost and Value of Kansas' Guaranteed CB Benefits

CB plans are defined benefit, the same as FAS plans. In the case of Kansas, although there is some upside risk-sharing, the benefits are largely guaranteed. Thus, the logic is the same

[34] Controlling for the different weights attached to the value of the guarantee at these two discount rates, the overall average would be 10.7 instead of 11.0 percent.

for discounting such benefits at a low-risk rate, to ascertain the value of the guarantee. If we do so, the overall normal cost rate rises by 9.7 percentage points, a rise of 144% over the actuarial rate of 6.7 percent. This is virtually identical to the corresponding impact for the FAS plan, a 142% rise over the actuarial rate of 7.7 percent, upon rediscounting. This may be coincidentally close, but the underlying similarity of these defined benefit plans explains why a cut in the discount rate would have comparable effects. Both plans offer annuities payable at 65 (or 60 with 30 years of service). Thus, if we consider the normal cost rate for any individual retiring at 65, a cut in the discount rate raises the present value of both plans' benefits (the numerator of the normal cost rate) by the same proportion (and the denominator for any individual's normal cost rate is the same between the two plans). So there would seem to be no difference in the value of the pension guarantee between the two plans, as a percent of their actuarial costs.

However, there is an important difference. For the FAS plan, the full benefit is guaranteed, independent of the discount rate, so the impact of rediscounting is the full story (in Table 3, Line A2 is the same as A1a for FAS). For the CB plan, however, the interest credit is only guaranteed at 4.00 percent, while the actuarial normal cost is calculated assuming 6.25 percent interest credit, to allow for generous dividends.[35] To calculate the value of the guaranteed benefit, we would cut both the discount rate and the assumed interest credit to the guaranteed rate (Line A2). As a result, the normal cost rises by only 4.4 percentage points, or 65% of the actuarial cost (Line A3, Table 3). That is the value of the CB plan's guarantee.

The value of the guarantee is much lower under the CB plan than the FAS plan. This impact on costs that are off-the-books, from 11.0 percent to 4.4 percent, far exceeds the plan's impact on employer costs that are on-the-books, from 1.7 percent to 0.7 percent. Thus, the

[35] As noted earlier, over the first five years of the plan, the actual interest credits compounded to only 4.38 percent.

primary gain for Kansas' fiscally distressed system of moving from FAS to CB was arguably to reduce the system's unreported cost of risk, rather than the actuarially calculated contribution. In addition, the value of the guarantee is more evenly distributed.[36] Our summary measure of redistribution is only 1.0 percent of the cohort's PV of earnings for the CB guarantee, well below the corresponding figure for the FAS guarantee of 4.7 percent.

6. THE IMPACT OF REDUCING THE ASSUMED RETURN: KANSAS' FAS VS. CB PLANS

In assessing the off-the-books value of the CB plan's guaranteed benefit, I did not mention any adjustment to the plan's annuitization rate of 5.75 percent, the interest rate effectively credited to the retirement balance *after* retirement. That is because this rate is part of the guarantee: it is set by statute at 2 percentage points below the assumed return. Thus, unless the assumed return is cut, that benefit stays intact. That provision is part of the plan itself, unlike the plan's assumption of 6.25 percent interest credit prior to retirement, which enters the actuarial cost, but not the actual guaranteed benefit. This raises an interesting and pertinent policy question: how does a cut in the assumed return affect the costs, on- and off-the-books, in a CB plan, and how does it compare with the impact on an FAS plan?

For the FAS plan, as is well-known, a cut in the assumed return raises required contributions, in order to reduce the likelihood of future unfunded liabilities. The benefit itself, however, does not change; it simply brings costs onto the books that our analysis found to be off-the-books.[37] Specifically, consider a cut in the assumed return from 7.75 to 6.00 percent. Table 3 depicts the costs, on-the-books and off, for the two assumed returns (Panels A and B) and the

[36] Compare Figure A.4 with Figure A.3, available in the online appendix.
[37] Our discussion here continues to be restricted to the normal cost. Cutting the assumed return also accelerates the amortization payments on the unfunded liability, which adds to policy-makers' reluctance to cut the rate.

impact of such a cut (Panel C). For the FAS plan, the actuarial cost rises by 3.6 percentage points (Line C1), the difference between the normal cost rates at 6.00 and 7.75 percent (Lines B1 and A1). Since the benefit is unaffected by a drop in the assumed return, neither is its full cost (Lines A2 and B2). Thus, the 3.6-point rise in actuarial cost (Line C1) simply brings onto the books 3.6 points that were previously off-the-books (Line C3). A cut in the assumed return is a step in the direction of transparency, but it is a step policy-makers are often reluctant to take, because it requires a significant rise in contributions.

The impact of a cut in the assumed return is somewhat different for a CB plan, structured as in Kansas. The key point here is that a cut in the assumed return will reduce the guaranteed benefit. The reason is that the annuitization rate is set, by statute, at two points below the assumed return. Thus, cutting the assumed return will cut the annuitization rate, effectively cutting the guaranteed return on retirement balances after retirement. Cutting the assumed return will not, in and of itself, reduce the guaranteed interest credit, earned prior to retirement, but it reduces the annuity rate, thereby cutting the full cost of the guaranteed benefit.

The remaining question, then, is how much of that cut in the full cost is on-the-books (i.e., contributions) and how much is off-the-books. As discussed above, the key determinant of CB contributions is not so much the assumed rate of return as the two spreads. The annuity spread is fixed in statute. The other spread that governs contributions is between the assumed return and the assumed interest credit. This spread is likely (though not required) to remain approximately unchanged, since the assumed credit includes dividends, contingent on asset returns. With both spreads unchanged, one may expect minimal impact on the required contribution from a cut in the assumed return. As a result, with little change in the cost that is on-the-books (the required contribution), the drop in the full cost of the guaranteed benefit would primarily be off-the-books. Thus, for both costs, on-the-books and off, a drop in the assumed return under a spread-preserving CB plan is likely to compare favorably with an FAS plan.

These results are illustrated in Table 3. At 7.75 percent assumed return, the CB plan's actuarial cost is 6.7 percent (Line A1). Panel B shows that at 6.00 percent assumed return, the actuarial cost barely rises, to 6.9 percent (Line B1). This is quite muted, compared to the impact of cutting the assumed return in the FAS plan. Again, that is because the two spreads are unchanged. The annuitization rate drops statutorily to 4.00 percent, preserving the 2-point spread, and we postulate that the assumed interest credit drops to 4.50 percent, preserving the 1.5-point spread.[38] As a result, contributions only rise 0.1 point (Line C1).

The full cost of the CB plan's guaranteed benefit, taking all interest and discount rates at 4.00 percent, is 10.0 percent (Line B2). This is virtually indistinguishable from the sticker price discussed above.[39] The cut in the assumed return still leaves 3.1 percent off-the-books (Line B3), but reduced from 4.4 percent (Line A3). Panel C summarizes: cutting the assumed return reduces the full cost of the guaranteed benefit by 1.1 points (Line C2), as the cost that is off-the-books drops by 1.3 points (Line C3), with almost no rise in contributions, 0.1 point (Line C1). Thus, a cut in the CB plan's assumed return part way toward the low-risk rate, while maintaining the two spreads, would enhance transparency and reduce the cost of risk, but, unlike FAS, should occasion little push-back from policy-makers adverse to contribution hikes.

[38] This still covers dividends, at the rate granted over the first five years of the program.

[39] See Figures A.2 and A.1, available in the offline appendix. The only visible difference is the lower cost prior to vesting. Overall, reducing all rates from 7.75 to 4.00 raises the normal cost to 10.3, but vesting cuts it back to 10.0.

6. Conclusion: Summary and Policy Considerations

CB pension plans have been recommended for some years as an alternative to traditional FAS plans. A major rationale put forth was to ameliorate the inequities generated by the back-loaded benefit structure of FAS plans. Indeed, the wave of private sector conversions to CB, decades ago, was seen at the time as an employer response to the emergence of a higher-mobility workforce, penalized by traditional plans. Those inequities are particularly salient for teachers, since they have high turnover in their early years. And yet, even as public retirement benefits have been reformed over the last decade, only one state has adopted a CB structure for teachers. It is not hard to speculate on the reasons that the equity rationale has failed to gain traction. The political forces for reforms that would benefit young, mobile teachers have inevitably proven weaker than those for preserving the distributional status quo, favoring senior members.

Clearly the most decisive factor in teacher plan reform is cost. Under continuing fiscal distress, policy-makers seek to cut contributions and reduce risk. They also seek politically palatable ways of doing so. It is in this context that one may view the move from FAS to CB in the one state that has undertaken this reform for teachers. As other states consider such a move, there are important lessons suggested by the Kansas example regarding contributions, risk, and the potential tension between political palatability and transparency.

I find that the Kansas plan modestly reduced the already-low employer contributions for currently accruing benefits (normal costs) and, more importantly, considerably reduced the off-the-books cost of the pension guarantee. At the same time, the plan appeared to offer a somewhat more generous employer contribution match, which may have helped the plan's political viability. The mechanics of this hat trick lie in the somewhat arcane actuarial details laid out above, but the key feature of a well-designed CB plan is for the guaranteed portion of the return on retirement balances to approximate a low-risk market rate, as in Kansas. As a result, the full employer cost of the guaranteed benefits – discounted at the same low-risk rate – will approximate the stated employer match. The fundamental advantage for Kansas is that the full employer cost (5.1 percent) is considerably lower than that of the FAS plan (12.7 percent).

The portion of this cost that is on-the-books – the actual employer contribution – is kept low in both CB and FAS plans, but by different mechanisms. For FAS plans, high assumed returns keep contributions low, but do not affect benefits, leaving the high cost of risk off the books. For CB plans, however, contributions depend less on the level of assumed returns than on the spreads; for a modest spread between assumed return and interest credits, the cost of risk that is left off the books is more limited.

The use of such spreads in CB plans may aid political viability, by keeping contributions low while guaranteeing the equivalent of a reasonably competitive employer match, but it does raise the issues of transparency and risk.[40] At the very least, it should be uncontroversial to transparently *report* the full cost of guaranteed benefits, discounted at a low-risk rate. As discussed earlier, finance economics shows that public pension liabilities should be reported in this fashion, and that would also apply to their rate of accrual, the normal cost rate. However, it does not necessarily follow that contributions should be set at that rate. Public plans may choose to bear risk, provided they are cognizant of the possible adverse future consequences, such as rising contributions or even insolvency.[41] However, the disclosure of the full cost should clarify the advantage a CB plan may have over FAS, and the policy options for reform.

[40] See Glaeser and Ponzetto (2014) for a very thorough political economy model of how the "shrouded" costs of local public pensions inefficiently raise the share of compensation that goes to pensions when benefits are set in a decentralized fashion. In that model, the information asymmetry is between voters and public employees, who know more about the cost of their pensions. The information asymmetries that I (informally) postulate in this paper are between pension policy-makers and a less-informed public (hence, more of a Leviathan concept of government) and public employees, who may also be less informed than the policy-makers regarding costs.

[41] See Costrell and McGee (2020) for a proposed framework to present and evaluate such tradeoffs.

In the case of Kansas, it appears that the system gained by adopting a CB plan with significantly lower full costs than the FAS plan it replaced (11.1 vs. 18.7 percent). It did so by setting the interest credit at a low-risk market rate of return (4.0 percent), while maintaining its appeal by guaranteeing reasonably competitive employer contribution credits (averaging about 4 percent). Like all plans – FAS, CB, or even 401(k)-type defined contribution plans – that fund benefits with risky assets, this plan incurs risks. Similar to FAS (but unlike defined contribution plans), Kansas' CB plan bears the downside risk, and shares in some of the upside risk, by virtue of its dividend provision. The optimal allocation of risk is a decision of policy and politics that is beyond the scope of this article. The cost of risk, however it is allocated, can be somewhat objectively measured, as illustrated in this paper, and, as Kansas has shown, CB plans can be designed to reduce that cost. Such plans also distribute benefits more equitably, both on-the-books, as has long been known, and off-the-books, as shown here. But quite aside from the distributional advantages, states that are considering reform in our increasingly cost-and-risk-conscious environment could do worse than looking at the CB model of Kansas.

As we have seen, by setting the plan's two interest rates below the assumed return, employer normal cost contributions were actually cut, while offering a seemingly more generous "sticker price" for the employer match. One may speculate that this rendered the plan more politically acceptable. There are more transparent ways of implementing a CB plan. For example, under the CB plan for neighboring Nebraska's state employees, the interest rate for annuitization was statutorily set at the assumed return of 7.75 percent. In addition, the statutorily-specified employer contributions to the individual retirement accounts are actual (not bookkeeping) dollars (Nebraska Public Employees Retirement Systems 2020). However, Nebraska had no unfunded liability upon conversion to CB, since the prior plan was defined contribution. Consequently, there were no amortization payments, so the CB plan could afford to offer a relatively generous employer match (156 percent of the employee contribution). Kansas was not in such a fortunate position. Nonetheless, as I have shown, even under its current structure, Kansas could move in the direction of greater transparency by cutting its assumed return, without materially raising contributions.

As the world changes in the wake of Covid, states that find themselves caught between fiscal duress and interest group pressures may find that CB plans offer a politically viable vehicle to cut the costs of risk. Ideally, this would entail transparently reporting that benefits remain competitive with the private sector, once accounting for the value of the pension guarantee.

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Table 1: Cross-Subsidies, KPERS FAS vs. CB. *r* = 7.75%		
Measures (all in % of Earnings)	**FAS**	**CB**
Overall Normal Cost	**7.7**	**6.7**
Range of Normal Costs	3.7 to 12.4	5.2 to 7.8
Range of Cross-Subsidies	–4.0 to +4.7	–1.5 to +1.1
Losers/Winners	81/19	77/23
Losers/Winners Share of PV of Earnings	48/52	40/60
Share of Earnings Redistributed	2.1	0.7
Employer-Funded Benefit	1.7	0.7
Employer-Funded Benefit for Losers/Winners	–0.5/+3.8	–0.2/+1.3

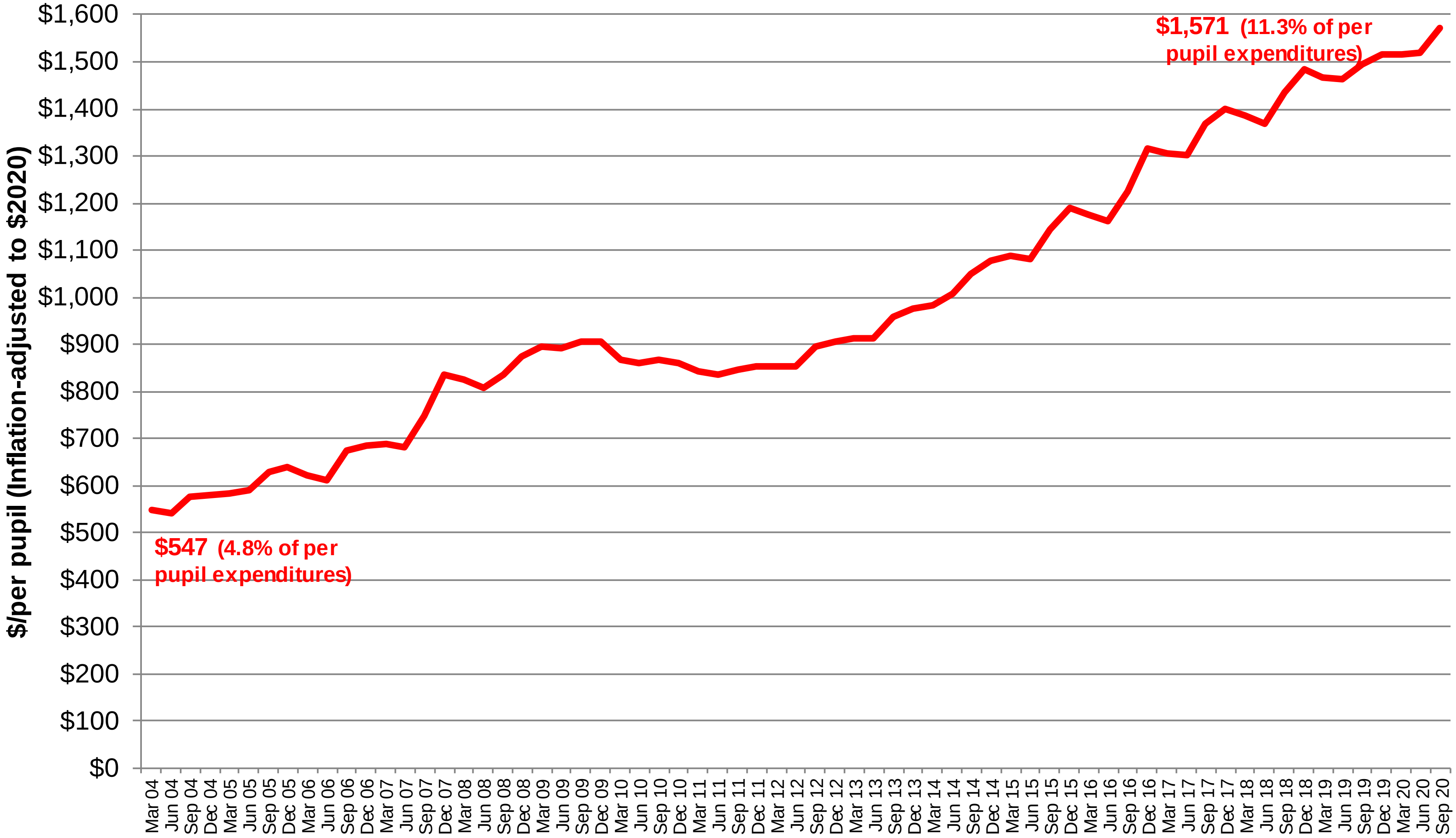
Table 2: KPERS FAS vs. CB Plan Design		
	FAS	**CB**
Annual Retirement Benefit	Years of Service × 1.85% × FAS	Annuity from retirement balance (annuity rate 5.75%)
Guaranteed Benefit	All of the above	Guaranteed interest (4.00%)
Potential Extra Benefit	None	Contingent dividends
Employee Contribution	6.00%	6.00%
Employer Normal Cost Rate	Calculated to fund FAS benefit formula, given assumed investment returns (7.75%)	Calculated to fund annuity from retirement balance of employee contributions and employer contribution credits (3 – 6%), at assumed interest credit (6.25%), given assumed investment returns (7.75%)
Vesting Period	5 years	5 years
Benefit from Vesting	Eligibility for pension	Employer contribution credits toward retirement balance
Eligibility for pension/annuity	Age 65/5 years service Age 60/30 years service	Age 65/5 years service Age 60/30 years service

Table 3: Actuarial Cost and Value of Guarantee, KPERS FAS vs. CB		
Measures (all in % of Earnings)	**FAS**	**CB**
A. Assumed Return 7.75%		
A1. Actuarial Cost @ 7.75% (on-the-books)	7.7	6.7[1]
A1a. Discounted @ 4.00%	18.7	16.4[1]
A2. Full Cost of Guaranteed Benefit @ 4.00%	18.7	11.1[2]
A3. Value of Guarantee (off-the-books) (A2 – A1)	11.0	4.4
B. Assumed Return 6.00%		
B1. Actuarial Cost @ 6.00% (on-the-books)	11.3	6.9[3]
B1a. Discounted @ 4.00%	18.7	10.8[3]
B2. Full Cost of Guaranteed Benefit @ 4.00%	18.7	10.0[4]
B3. Value of Guarantee (off-the-books) (B2 – B1)	7.4	3.1
C. Impact of Cutting Assumed Return from 7.75% to 6.00%		
C1. Actuarial Cost (on-the-books) (B1 – A1)	**+3.6**	**+0.1**
C2. Full Cost of Guaranteed Benefit (B2 – A2)	**0.0**	**–1.1**
C3. Value of Guarantee (off-the-books) (B3 – A3)	**–3.6**	**–1.3**

[1] Actuarially assumed 6.25% interest credit; 5.75% annuitization rate.
[2] Guaranteed benefit of 4.00% interest credit; 5.75% annuitization rate.
[3] Actuarially assumed 4.50% interest credit; 4.00% annuitization rate (same spreads).
[4] Guaranteed benefit of 4.00% interest credit; 4.00% annuitization rate.

Figure 1. Employer Contributions Per Pupil for Retirement Benefits

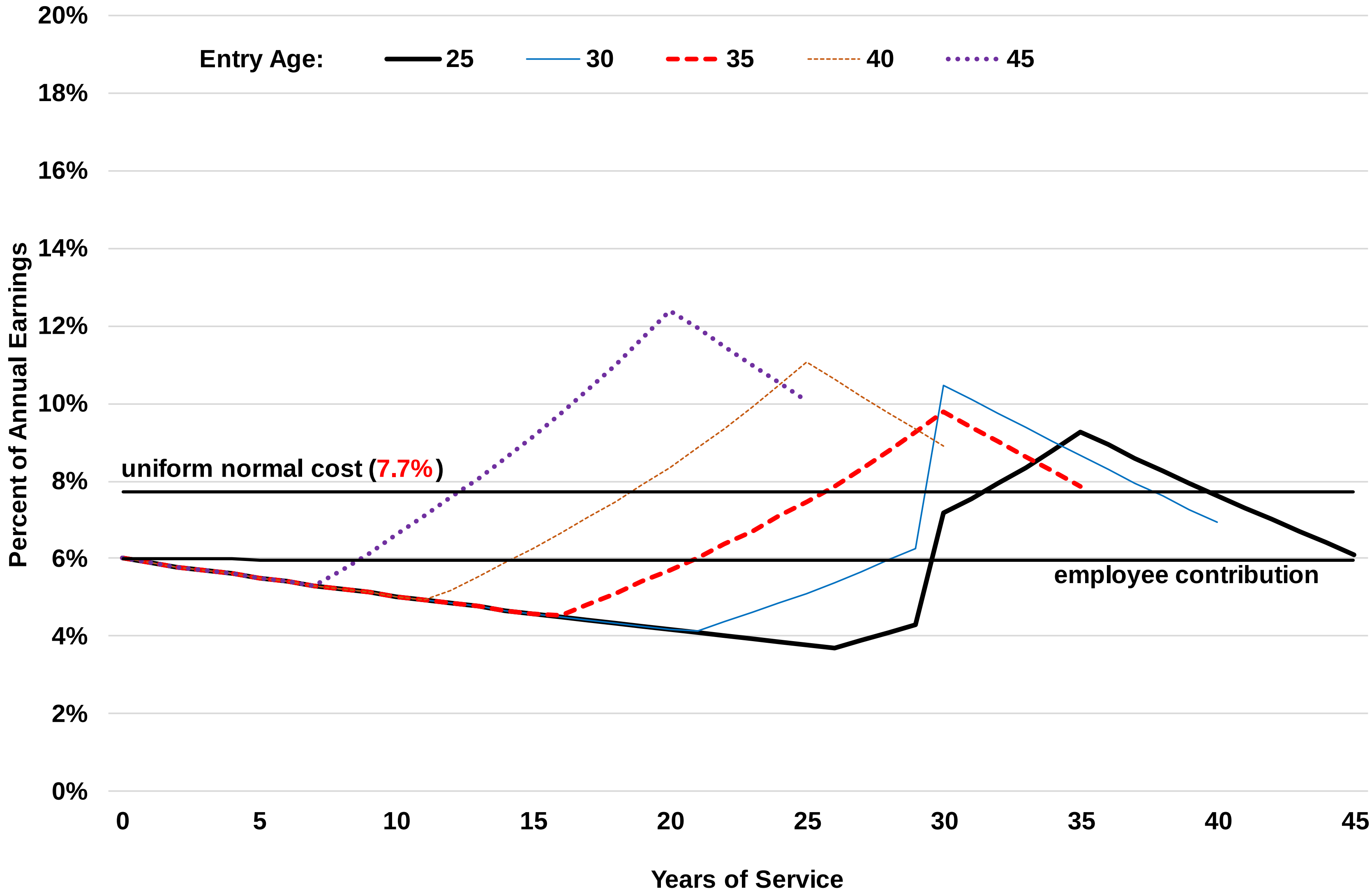
U.S. Public Elementary and Secondary Schools, teachers & other employees, 2004-2020



Sources: BLS, National Compensation Survey, Employer Costs for Employee Compensation;
NCES Digest of Education Statistics; BLS, CPI; author's calculations explained in Robert M. Costrell:
http://www.teacherpensions.org/blog/school-pension-costs-have-doubled-over-last-decade-now-top-1000-pupil-nationally
Note: Does not include retiree health benefits or Social Security

Figure 2. Normal Cost Rates, FAS Plan, by Years of Service & Age of Entry

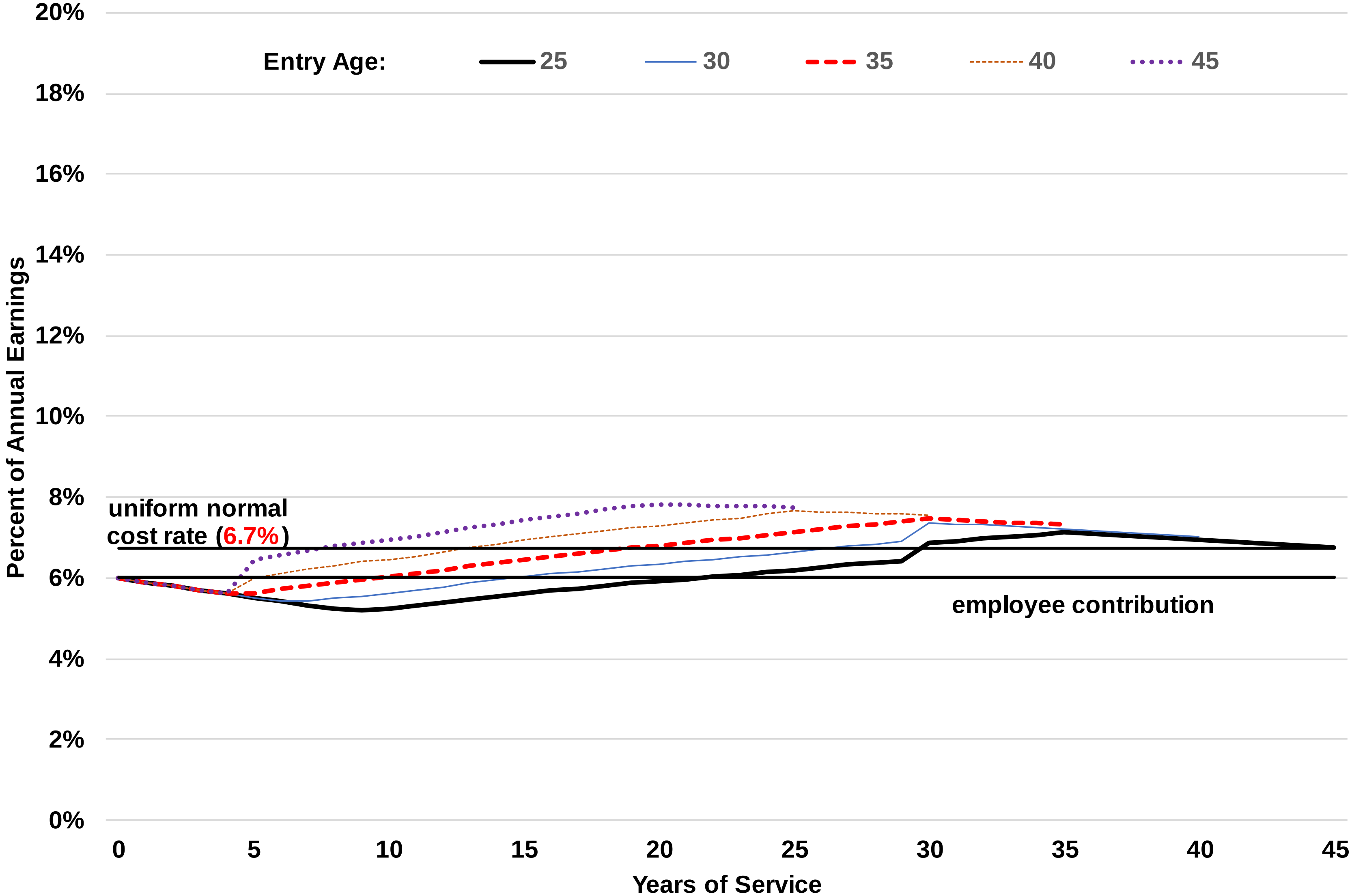
Estimated using 2020 KPERS school assumptions and Tier 2 benefit formula, r = 7.75%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual of entry age e and s years of service.
Variation by years of service is shown along each curve; variation by age of entry is shown across curves

Figure 3. Normal Cost Rates, CB Plan, by Years of Service & Age of Entry

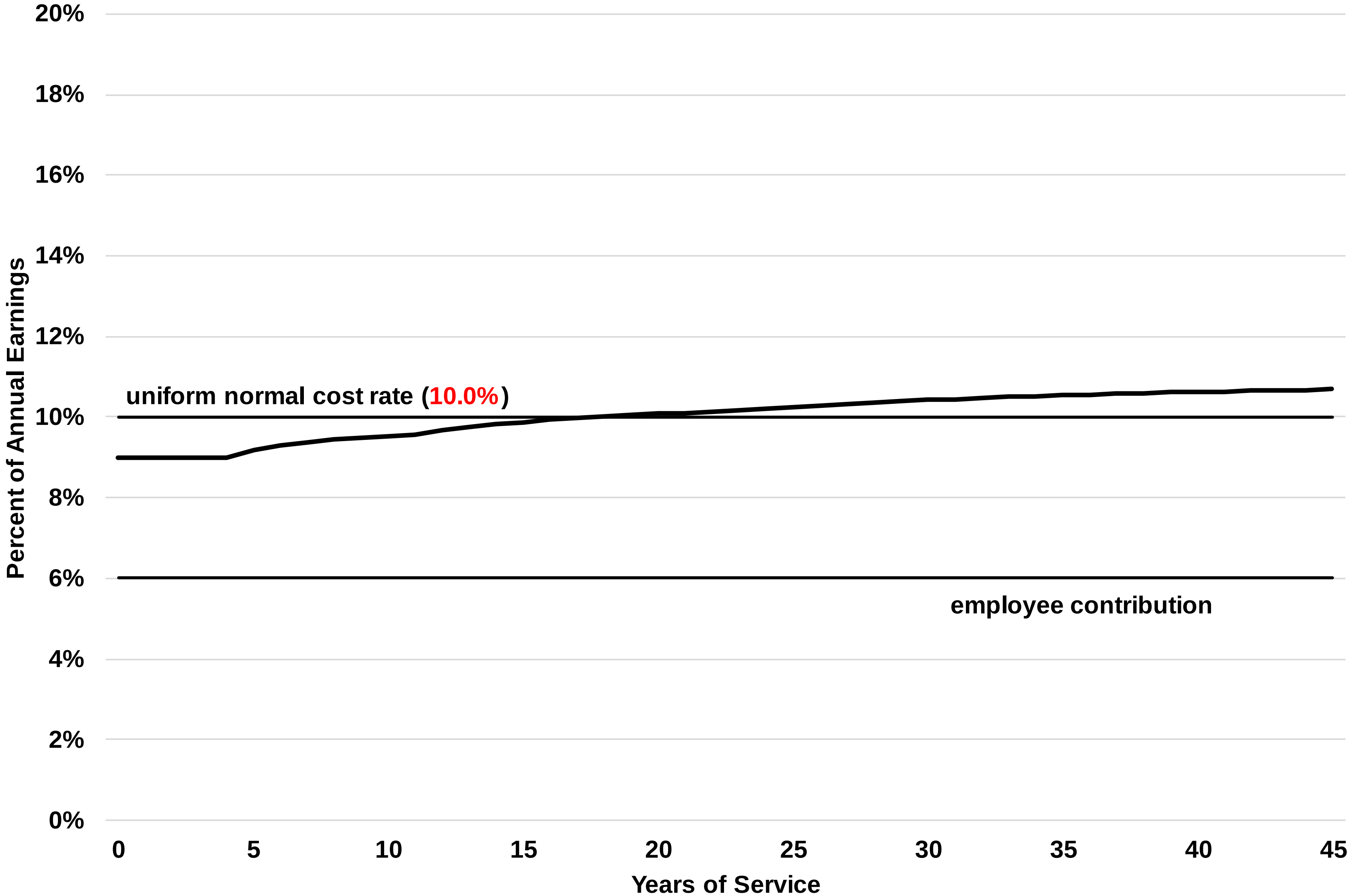
Employer credits = 3 - 6%. 5-year vesting. annuity interest = 5.75%, interest credit = 6.25%, discount rate = 7.75%



The curves depict n_{es}, the annual contribution rate required to fund benefits of an individual of entry age *e* with *s* years of service.

Figure A.1. Normal Cost Rates, CB Plan: Sticker Price (All Entry Ages)

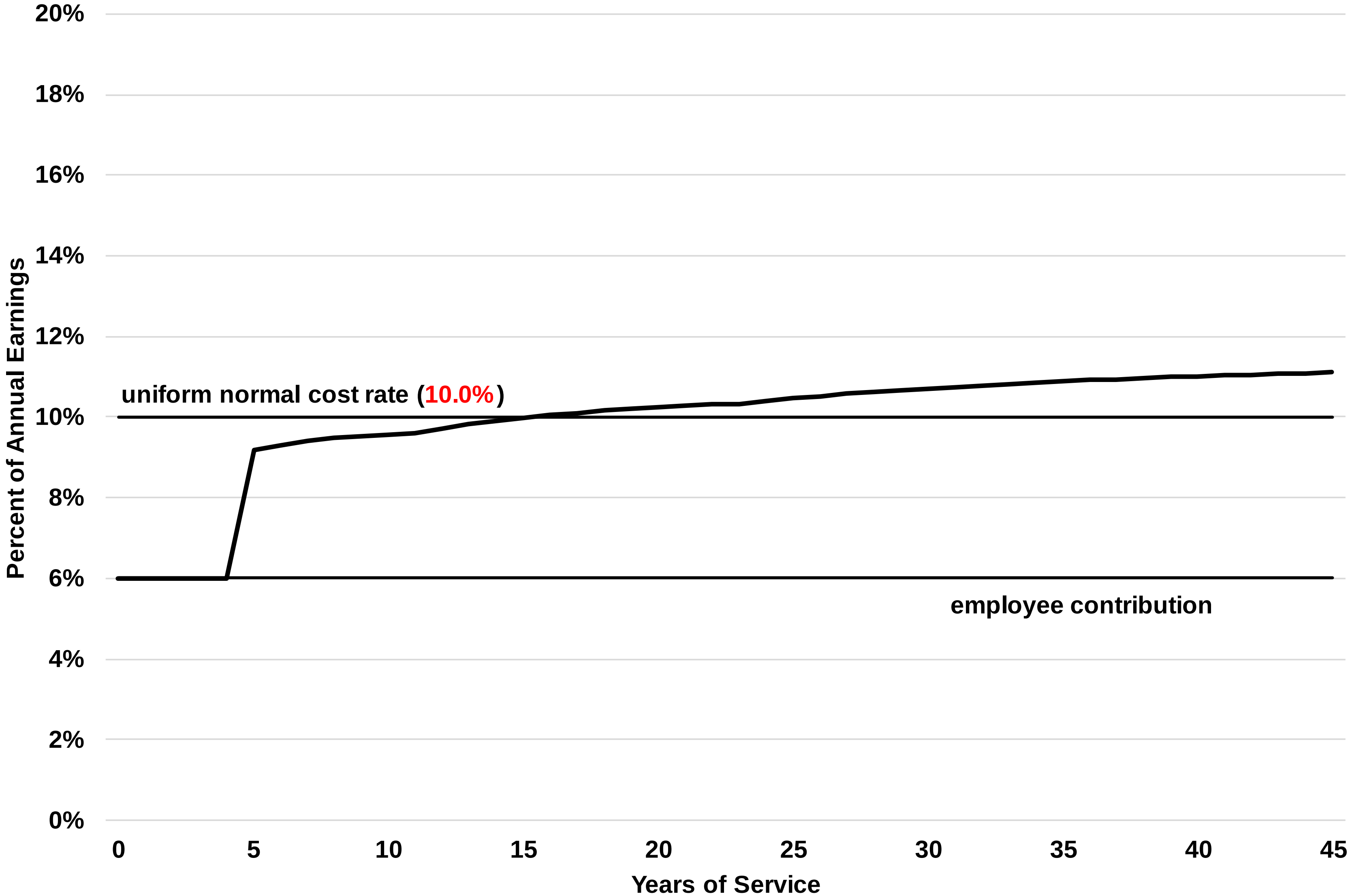
Employer credits = 3 - 6%. Immediate vesting. discount rate = interest credit = annuity rate = 7.75%



The curves depict the annual contribution rate required to fund benefits of an individual of any entry age with *s* years of service.

Figure A.2. Full Cost Rates, CB Plan Guaranteed Benefit (All Entry Ages)

Employer credits = 3 - 6%. 5-year vesting. discount rate = interest credit = annuity rate = 4.00%



The curves depict the annual contribution rate required to fund benefits of individuals entering at any age with *s* years of service.

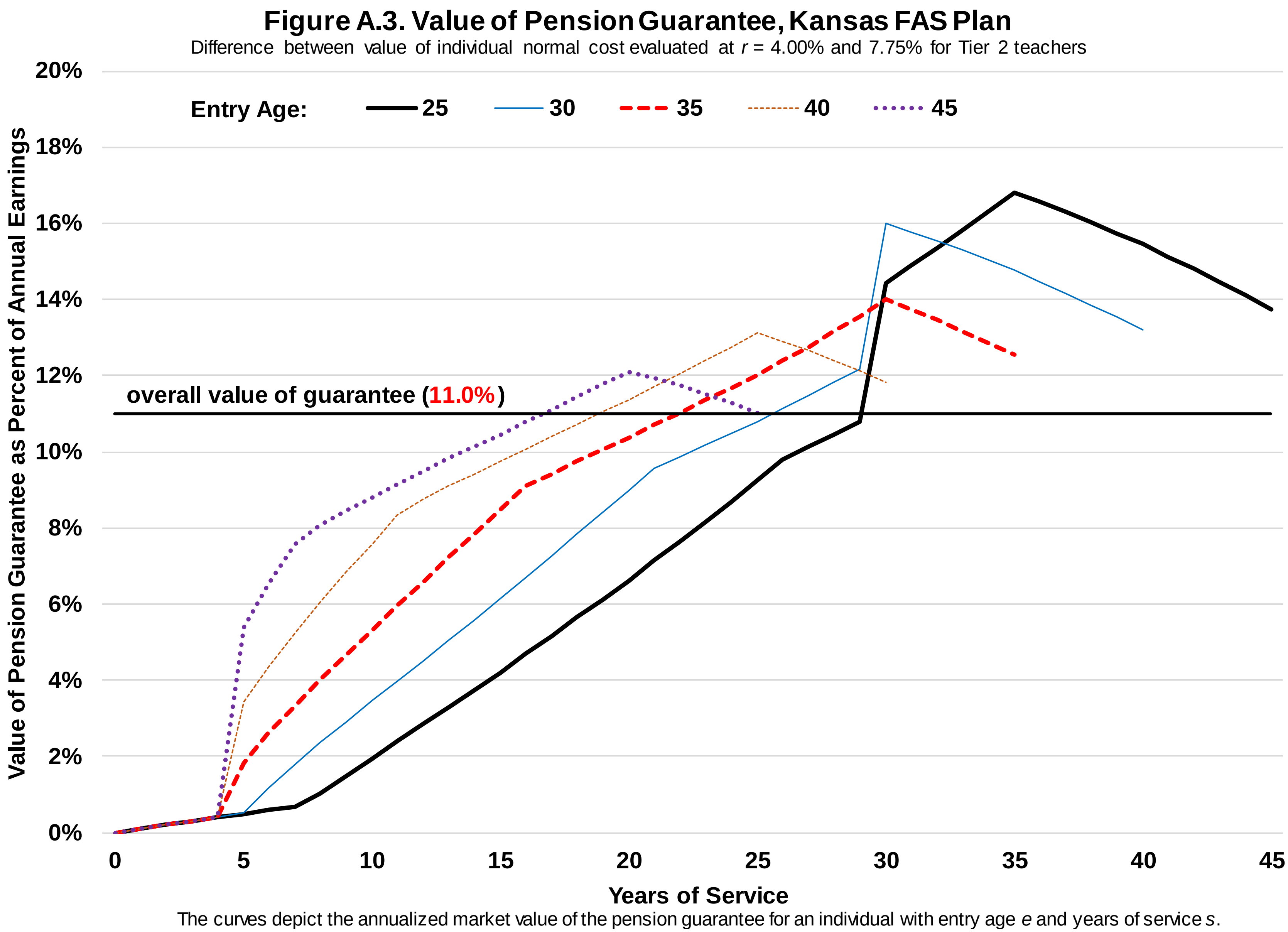


Figure A.3. Value of Pension Guarantee, Kansas FAS Plan
Difference between value of individual normal cost evaluated at r = 4.00% and 7.75% for Tier 2 teachers
Entry Age:
25
30
35
40
45
overall value of guarantee (11.0%)
Value of Pension Guarantee as Percent of Annual Earnings
0%
2%
4%
6%
8%
10%
12%
14%
16%
18%
20%
0
5
10
15
20
25
30
35
40
45
Years of Service
The curves depict the annualized market value of the pension guarantee for an individual with entry age e and years of service s.

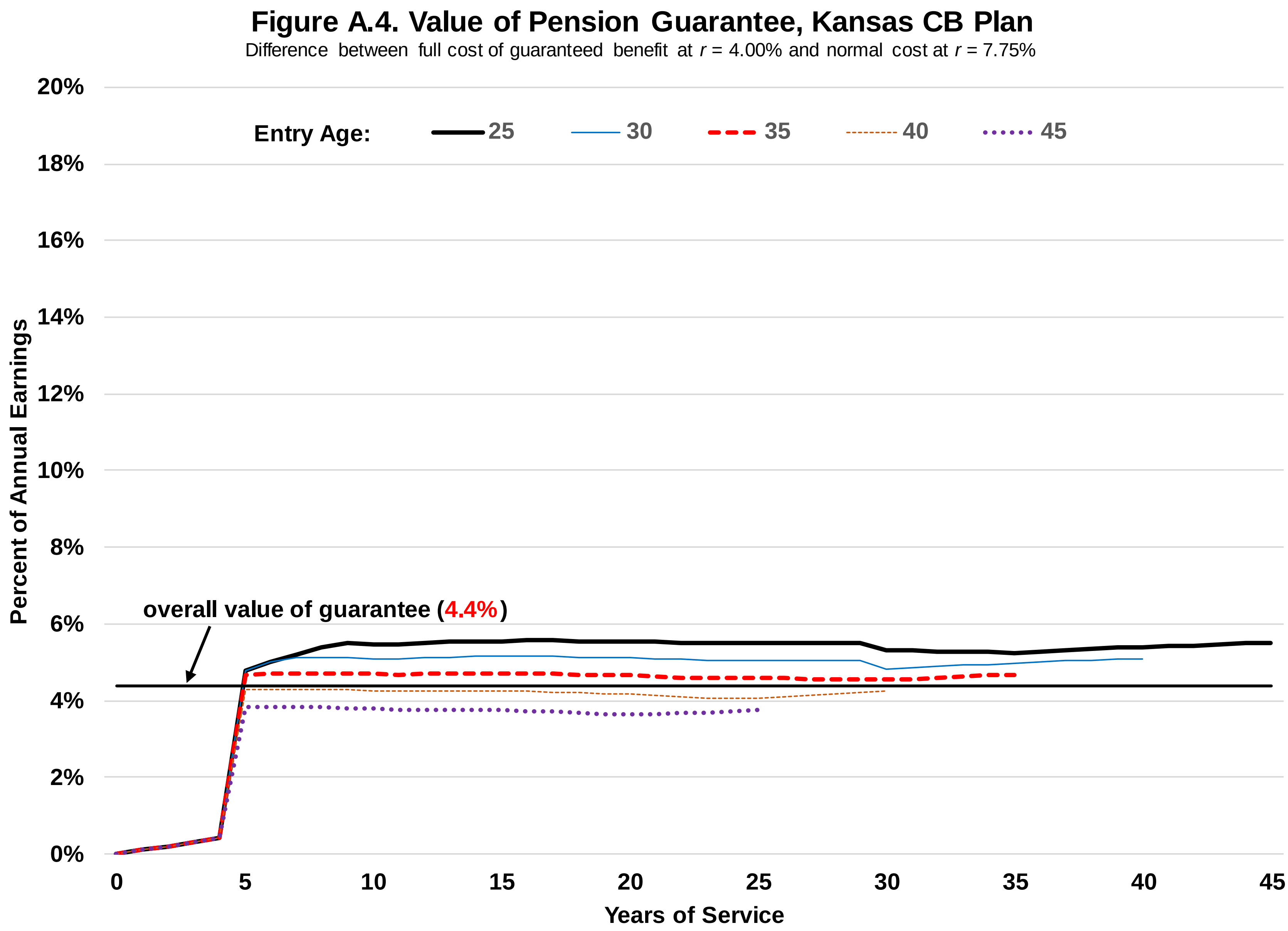


Figure A.4. Value of Pension Guarantee, Kansas CB Plan
Difference between full cost of guaranteed benefit at r = 4.00% and normal cost at r = 7.75%
Entry Age:
25
30
35
40
45
overall value of guarantee (4.4%)
Percent of Annual Earnings
20%
18%
16%
14%
12%
10%
8%
6%
4%
2%
0%
0
5
10
15
20
25
30
35
40
45
Years of Service